REPORT

ON THE ACTIVITIES OF

THE INTERNATIONAL TELECOMMUNICATION UNION

in

1966

Published by the
International Telecommunication Union
Geneva, 1967

of the Conclusions of the Interim Meetings, and the other on the setting up of an International Working Party to consider organizational measures to make the work of the C.C.I.R. more effective.

The Director, C.C.I.R., in collaboration with this Working Party, the Chairman of Study Groups and in consultation with the members of the Secretariat is actively engaged in studies to assist the Working Party in the preparation of concrete proposals for improving the methods of working.

5.4 ACTIVITIES OF THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE (C.C.I.T.T.)

1. *Work of Study Groups in 1966*

1.1 The Study Groups, Working Parties and Specialized Working Parties for technical assistance were extremely active in 1966.

The meetings held in 1966 are shown in the table below.

LIST OF C.C.I.T.T. MEETINGS HELD IN 1966

Date	Subject of the meeting	Place
10-18 January	GAS/2 (local networks)	Geneva
7-11 February	WP 33/XV (pulse code modulation systems)	”
21 February-2 March	GAS/3 (economic and technical comparison of transmission systems)	Rabat
21 February-2 March	Study Group VII (definitions and symbols)	Geneva
7-11 March	Special Study Group C (noise)	”
15-17 March	WP 3/XIV (channels for facsimile telegraphy)	”
21 March-1 April	Plan Committee for Europe and the Mediterranean Basin	Paris
28 March-1 April	WP IV/5 (maintenance instructions for new systems)	Geneva
13 April	GAS/1 (national automatic networks)	New York
14-22 April	Study Group XI (telephone switching and signalling)	New York
25 April-3 May	Study Group XIII (automatic and semi-automatic telephone networks)	”
25-29 April	GAS/4 (primary energy sources)	Geneva
25-29 April	WP ALP (new telegraph alphabet)	Paris
27-29 April	WP SYN (synchronous telegraphy)	Geneva
2 May	Laboratory WP	”
2-5 May	Study Group VIII (telegraph apparatus and local subscriber lines)	”
3-9 May	Study Group XII (telephone transmission quality and local telephone networks)	”
4-6 May	Special Study Group B (world automatic and semi-automatic telephone network)	New York
6-10 June	Study Group XVI (telephone circuits)	Geneva

Date	Subject of the meeting	Place
13-21 June	WP IV/1 (maintenance of category B circuits)	Geneva
7-20 September	Plan Committee for Asia and Oceania	Melbourne
8-14 September	WP MRT (message retransmission)	"
15-21 September	WP TGX (world telex and gentex routing and transmission plan)	"
22-26 September	WP EFF (efficiency factor)	"
22 Sept.-4 Oct.	Study Group I (telegraph operation and tariffs)	
26-30 September	WP IV/3 (routine maintenance programme; sound and television broadcasting circuits)	Geneva
26 Sept.-4 Oct.	GAS/2 (local telephone networks)	"
3-6 October	WP IV/2 (measuring equipments)	"
3-7 October	Study Group X (telegraph switching)	Melbourne
17-19 October	WP LTG (use of lines for telegraphy)	Geneva
19 October	WP 14/XV (group. etc., pilots for data transmission)	Geneva
19-26 October	WP XI/1 (Signalling System No. 6)	Prague
20-24 October	WP on 12-MHz systems and WP on small coaxial pairs	Geneva
21-24 October	WP on compandors	"
25 Oct.-4 Nov.	Study Group XV (transmission systems)	"
7-16 November	Analysis Group of GAS/5	"
14-23 November	WP IV/4 (quality of the international network)	Paris
24 Nov.-2 Dec.	Study Group IV (maintenance of lines, circuits and circuit chains)	"
2 December		
28 Nov.-9 Dec.	Study Group II (telephone operation and tariffs)	Geneva
12-16 December	Study Group III (general tariff principles — lease of telecommunication circuits)	"
12-16 December	Joint WP V/VI (drafting of handbook on protection from lightning)	"

Forty meetings were thus held covering 278 days in all (25 meetings and 197 days in 1965).

The most important results of these meetings, in each main field of activity, are as follows:

1.2 *Telegraphy*

1.2.1 *Telegraph technique*

With the new Alphabet No. 5 (see under Data transmission) and the development of 100-baud and 200-baud telegraph channels, telegraphy, influenced by the needs of data transmission, is turning towards the use of more rapid equipment in order to meet new demands. Study Group VIII (telegraph apparatus) is now examining the standardization required for the operation of such apparatus on an international scale.

Agreement was reached on synchronous multiplex telegraphy (without ARQ) which will be used on very long submarine cables.

Studies of the message retransmission network made it possible to supplement the rules already proposed by standardizing the procedures for dealing with minor operational difficulties and organizing cooperation with the gentex network. The first list of destination indicators was agreed and published.

Intensive studies were carried out regarding the introduction of fully automatic working in the telex network. Type C signalling was defined as well as the conditions for use of special channels (radiotelegraph channels with ARQ or channels established on synchronous multiplex equipment). Study of the use of satellite channels was begun. Solutions were proposed to various important questions concerning the following:

— start of the chargeable duration of telex calls for international accounts;

— precautions to be taken if ARQ is used on automatic connections;

— precautions against head-on collision of calls on circuits operated in both directions.

Finally, preliminary discussions were held on the new telegraph switching problems posed by equipment with a modulation rate higher than 50 bauds and by data transmission.

1.2.2 *Telegraph operation*

Work was begun on the problem of simplifying the counting of words with a view to evolving procedures compatible with automatic checking.

Detailed draft proposals were drawn up on the introduction of page printers in the gentex network.

Precise proposals were framed on the transferred accounts service.

An overall review was made of the lists, statistics, tables, etc., required for the telegraph service with a view to adapting the information to contemporary needs, avoiding duplication and eliminating useless data.

Study Group I (Telegraph operation und tariffs) set up a working party to consider how the Telegraph Regulations might be simplified in accordance with Resolution No. 36 of the Montreux Plenipotentiary Conference.

1.3 *Data transmission*

The important event of the year was the agreement achieved between Sub-Committee 2 of I.S.O. Technical Committee 97 and the C.C.I.T.T. “ New Alphabet ” Working Party on a 7-bit alphabet with an extra bit for parity check (Alphabet No. 5).

The main feature of this alphabet is that there are 32 non-printing combinations for control and checking operations and 96 combinations for graphic signs. The correspondence established between graphic signs and combinations constitutes the basic alphabet for normal use, but it is possible to leave the basic alphabet and use alphabets of special graphic signs and then to revert to the basic alphabet. The 32 combinations for operations and checking, on the other hand, have strict assignments, although they may be added to.

This alphabet is provided for data and message transmission when Alphabet No. 2 proves inadequate.

It should be pointed out that the alphabet requires modulation rates in excess of 50 bauds.

After the Brussels meeting of Special Study Group A in December 1965, the year 1966 was devoted to studies and tests in line with the Brussels directives in preparation for the conclusions to be arrived at in 1967.

SUBJECT: TRIP REPORT ON X3 MEETING OF 67 JANUARY 18

1967 January 20

TO: Distribution "A"

1) Miscellaneous

A new Assistant Director of Standards for BEMA DPG, Nathaniel Stone, was present. Doug Ross of MIT has been appointed the principal member for ACM. Representatives of Printing Industries of America were present and will take their seats officially at the next meeting, which is April 13. The new USASI procedures go to the member body committee on January 26 for vote.

2) Proposed X3 scope is essentially agreed, with 26 yes and only 4 no. The basis of disagreement was the fear that X6 would get process control. Paul Goodstat stated he would check on revising the program of work assigned (with this new scope) to prevent this.

3) A U.S. vote of approval has been submitted for the draft ISO proposal on Dimensions for Punched Paper Tape.

4) The report of the ad hoc committee on I/O Interfaces was accepted, but X3 did not feel that it warranted subcommittee status at this time. The 27-1 vote favored continuance on an ad hoc basis to clean up the scope, provide objectives, and report periodically to X3.

5) It was agreed that RS232-B (which is equivalent to CCITT-V24) should not be processed as a standard pending receipt of RS232-C, which is due the end of 67. EIA TR-30 has also been asked to provide the expository material at that time. This led to a discussion of modularity in standards, and I have been asked to draft a policy on this for the next meeting.

6) The draft on Character Structure and Parity Sense (parallel-by-bit) was approved (27-1-1) for publication and letter ballot.

7) So was the COBOL draft (26-0-2) on the same basis as X3.4 had approved; that is, contingent upon technical approval of the editorial work by X3.4.2 and X3.4.4.

8) Flowchart conventions were also approved (27-0-1) for publication and final letter ballot without publication cycle, as they were published over a year ago. This brought a discussion of mechanical procedures in issuing standards, inasmuch as Germany has proposed that the symbols and the conventions form a single-numbered standard, at least at the international level. This might conflict with the modular standard policy. The BEMA DPG staff will investigate.

NMAH 310/6

9) The takeup reel standard for one inch perforated tape was granted an extension to the next meeting only, waiting upon ECMA comments.

10) The draft standard on 11/16" perforated tapes was forwarded (25-0-3) to USASI.

11) The draft on rectangular holes in 12-row punched cards was also forwarded (25-0-3) to USASI. However, McKenzie of IBM, having been Chairman of X3.2.3, agreed that the BGE and French position on how to define the reference line on the top of the card required further resolution. In speaking to this the Chairman of X3, Charlie Phillips, stated that mechanical procedures were such that USASI could not issue a standard until this was resolved. Upon this assurance, I abstained for GE rather than cast a no vote. The other points listed by BGE, particularly those on accumulative tolerances, were dismissed by McKenzie and X3.2.3 as not meaningful in the real world. It would seem that BGE, as a volume manufacturer of punch cards, possibly agrees to this and is only concerned on the theoretical effect. It would be useful if they could provide some wording to satisfy themselves in this dilemma.

12) This concerns the X3.2 proposal for a compromise with the vociferous opposition on SHARE to prUSASCII. This was a conciliatory paper by X3.2 in response to X3.4's retraction of their statement of opposition. It was also responsive to ACM's yes vote on the proposed standard (I engineered both these reversals).

In opening the discussion, Phillips saw three difficulties:

a) The apparent requirement by X3.2 that all "No" votes in X3 (there were 5, IBM/API/RCA/JUG/Standard Register) be converted to "Yes".

b) The proposed changes might be construed as not editorial, but substantive.

c) X3.2 appeared to ask for commitments by manufacturers, which is contrary to the principle of voluntary USA standards.

He stated that the IPSSB vote was not complete, but that at least 4 negative votes are known.

Speaking for IBM, Haddad (who is rather influential as their Director of Engineering) said they could make no commitments, but noted that the suggestions of X3.2 can be accommodated under standard sales manual features, and in fact this has been so all along. He thought a specific exposition on this option could be placed in the same sales manual, and would go a long way in pointing out its possibility and feasibility. He said he would try to have a customer-directed publication focus on such a possibility. To close the loop he stated that no consideration has been given to withdrawing this possibility in the sales manuals. Here, Auwaerter, on behalf of X3.2, said that Haddad's statements met their intentions, and he thought Phillips had stated it rather too strongly.

This led to a rather general confession period. RCA's representative said he could not add anything to what Haddad had said, and that it stated their position nicely. Clamons said that Univac also would offer a publication to support this compromise. I moved the adoption of the first portion of the X3.2 paper as a real modification to the proposed standard, for 30-day letter ballot. This was seconded by Haddad. During the discussion American Petroleum Institute, which is on both X3 and IPSSB, said they would try to sell it but it would take at least 30 days, because they always got together at the SHARE meeting (February 13 in San Francisco).

Green stated that Standard Register would change, and that left only JUG. Utman stated they would not have another meeting until April. The motion passed (26-0-3) and Haddad requested that JUG and others take extraordinary measures to express vote reversal.

Here are some of the hidden meanings:

a) This compromise is technically unsound and unwarranted, but the effect is deemed to be minor and not realistically or logically in conflict with the draft ISO (Recommendation 1052) and CCITT standard codes.

b) IBM is very glad to save face, and they are jumping at this to do it. It was their customer group SHARE that went overboard on this, making outrageous demands on worldwide standards with the same nonchalance that they make outrageous demands on IBM. Thus IBM was pretty well caught in the middle. However, the compromise is not really what SHARE would wish it to be. Nevertheless, effecting this specific compromise at this time will give IBM the strength and backing it needs to resist firmly any further modification attempt by SHARE or JUG.

c) The success of this compromise depends rather critically upon good will and simultaneous reversals. Since I have been the major thorn in SHARE's side, with respect to their poor technical position, it was deliberate calculation on my part to be the mover of the motion. I am sure it was also deliberate by Haddad to be the seconder on behalf of IBM. This should give some psychological advantage to success.

d) It is interesting to note that American Petroleum Institute had to wait for the SHARE meeting before they could decide to change their vote. Many X3 members laughed embarrassedly when the API member made this slip.

e) If this foolishness had been allowed to go on much longer without practical compromise, the entire USASCII and international code standardization would have been jeopardized seriously by IBM's EBCDIC code in the 360.

13) With respect to approval of a scope and program of work for Joint X3.6.7-X3.4.2D, Carlson, of the Department of Defense, did not wish X3 to take any action. My motion to assign it exclusively to X3.4 lost 9-10-8. The result was 24-0-3 to not formalize anything further at this time, with open minds as to whether decision tables are, in fact, suitable for standardization. IBM, NCR and some others expressed little enthusiasm for this work.

14) The most crucial topic of the meeting concerned the 8-bit environment problem, which is presently only implicit in the draft magnetic tape standard. It is however explicit in TC97/SC2, where so far 5 countries have voted for $b_8=0$, two have said "lets talk further" and Japan has voted the IBM way. Tutorials followed. Griffin, Chairman of X3.2, gave the position of X3.2D, which remained $b_8=0$. McKenzie spoke on the history of IBM's decision to use the EBCDIC format, based upon 13 criteria of varying weight, all of which are impossible to answer by "yes". Lastly, Clamons presented Univac"s reasons for changing their position to concur with IBM. It must be stated that McKenzie's exposition was the best and extremely fair. The only flaw I could find was allowing at most a 64 contiguous character block for KataKana, since I recall my advice from IBM Japan was for a required 78 characters.

Clamons agruments were the most disturbing. His major points were:

a) The need for a so-called USASCII-6 for 6-bit computers.

b) That many $E_8=E_6=b_7$ computers exist.

To understand his argument, remember that if USASCII-6 consists of the central 4 sticks of USASCII-7 (markedly different from the 6-bit code in the ISO Draft Recommendation 1052), then the latter code is derived by:

$$E_{1-5} = b_{1-5}$$

$$E_6 = \neg b_6$$

$$E_7 = b_6$$

This is fixed. For the 8-bit environment, however, the two options being argued are X3.2's, which is:

$$E_{1-7} = b_{1-7}$$

$$E_8 = 0$$

and

IBM's, which is

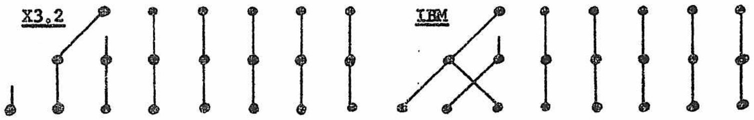
$$E_{1-5} = b_{1-5}$$

$$E_6 = b_7$$

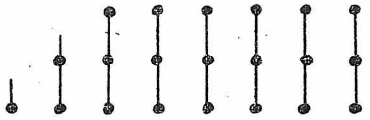
$$E_7 = b_6$$

$$E_8 = b_7$$

Pictorially the two options can be seen this way:



It is true that if a USASCII-6 were required, then the X3.2 position would be sounder if the arrangement of the present 7-bit code or USASCII-7 were controls, lower case, specials and numeric, upper case. In this case the picture becomes:



But, as I pointed out quite strongly, there are:

a) No 6-bit computers being built or planned for USASCII-6 and,

b) No existing 6-bit computers which could be retrofitted to use USASCII-6, for the simple reason that some of the 64 codes have been pre-empted by the existing hardware for control purposes. This is true, for example, in the IBM 1401, the 7080 and 7090. In fact, it is the 360 control codes already pre-empted for the edit which gives IBM their most strenuous objection to $b_8 = 0$! Clippinger took exception to my statement, saying that USASCII-6 could be represented in two 6-bit characters. I pointed out that this merely reinforced my argument, since USASCII-8 could also in the same two characters. Thus this apparently beautiful line of reasoning collapsed immediately.

None of the three IBM representatives there made any attempt to contradict my statements or support Glamons. I then reminded X3 that the many existing computers claimed by Glamons were in fact built to the EBCDIC code, not USASCII. Again no disagreement from IBM.

Several X3 members commended the exposition, mentioning that this was the first time they really understood the opposing viewpoints. Auwaerter's reply to this was amusing, to the effect that it was probably because it was the third time they had heard this presentation and it was "characteristic of this particular subject that the more you hear it, the more you think you understand it."

All the above may have very little influence on the vote on the draft standard for magnetic tape. It could be that this will not succeed at the X3 level. Then the only way to proceed will be to remove these considerations from the magnetic tape standard and put them in a separate environmental standard, which is what IBM wanted to have done two years ago, in which I concurred. The problem is that had one listened to IBM at that time the issue could have been settled much sooner and the EBCDIC adherents would not have their present strength. To my mind this is an interesting example of arbitrarily opposing IBM so hard that you gave them a distinct advantage.

15) The scope changes for X3.3 and X3.2 were approved without much discussion and almost unanimously.

16) A report from X3.5 found general disfavor in that they proposed to rewrite the present proposal and expand it. Further, many members felt that it was of more importance to bring together the new terms developing in the industry, particularly those of importance to the other X3.i subcommittees. It was also pointed out that the coherent structure of the IFIP/ICC vocabulary would be much more useful to these subcommittees than the present dictionary approach. The chairman invited several members to make written comments by February 15.

17) Attached is a partial meeting schedule which I have been able to assemble. Recipients of this report are requested to give further information (on the meetings noted below) to Mr. H.H. Green, who will reissue it periodically in a complete form.

R Bemer

R. W. Bemer

/cac

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HOLMDEL, NEW JERSEY
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67 FEB 9

MEMBERS X3.2:

Attached is further insight into the nomenclatural aspects of our work.

With respect to the last item of the article, it is of interest to note that the inhabitants of the parallel 41° 48' N* are never ASCII.

Yours very truly,

D. A. KERR
Member X3.2

Att.
As above

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* Which passes through such cities as Crescent City, California, Earling, Iowa and Poughkeepsie, New York.

NMAH 310 / 6

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—As, the *aſcetics*, or devout treatiſes of St. Baſil, archbiſhop of Cæſarea in Cappadocia.

We alſo ſay the *aſcetic life*, meaning the exerciſe of prayer, meditation, and mortification.—See MYSTIC.

A SECRETIS. See the article SECRETARY.

ASCETERIUM, ASSISTERIUM, ARCHISTERIUM, &c. are words frequently uſed among our ancient writers for a monaſtery. See MONASTERY.

ASCII*, in geography, are thoſe inhabitants of the globe, which, at certain times of the year, have no ſhadow. See EARTH, and SHADOW.

* The word is formed of the privative particle *α*, and *σκια*, *umbra*, ſhadow.

Such are the inhabitants of the torrid zone; by reaſon the ſun is ſometimes vertical to them. See TORRID and ZONE. —To find on what days the people of any parallel are *aſcii*. See GLOBE.

ASCITÆ*, in antiquity, a ſect or branch of Montaniſts, who appeared in the ſecond century. See MONTANIST.

* The word is derived from the Greek *ασκος*, a bag or bottle.

The *Aſcitæ* were ſo called, becauſe they introduced a kind of Bacchanals into their aſſemblies, who danced round a bag or ſkin blowed up; ſaying, they were thoſe new bottles fil-

USA standard

USAS
X3.4-1967
Revision of
X3.4-1965

Code for Information Interchange

CBI 94/2/ASCII

USAS
X3.4-1967
Revision of
X3.4-1965

USA Standard Code for Information Interchange

Sponsor

Business Equipment Manufacturers Association

Approved July 7, 1967

United States of America Standards Institute

TK5101
.U62

USA Standard

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Published by

United States of America Standards Institute
10 East 40th Street, New York, N. Y. 10016

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Universal Decimal Classification 681.3
Printed in USA
A20M767/2

Foreword

(This Foreword is not a part of the USA Standard Code for Information Interchange, X3.4-1967.)

This USA Standard presents the standard coded character set to be used for information interchange among information processing systems, communication systems, and associated equipment.

Other standards will prescribe the means of implementing this standard in media, such as perforated tape, magnetic tape, and punched cards. Further standards will deal with error control, data communication formats, keyboards, graphic representation of control characters, and code extension considerations.

The 7-bit coded character set was developed from a careful review of past work in the field, and, after a comprehensive program of original research and code design, was completed. Careful consideration has been given to the several conflicting code set requirements, and their resolution is reflected in the standard code.

This standard was approved as a USA Standard by the United States of America Standards Institute on July 7, 1967.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the United States of America Standards Institute, 10 East 40th Street, New York, N.Y. 10016.

The USA Standards Committee on Computers and Information Processing, X3, which developed this standard, had the following personnel at the time of approval:

C. A. Phillips, *Chairman* P. B. Goodstat, *Secretary*

Organization Represented	*Name of Representative*
Administrative Management Society	C. S. Everhardt
Air Transport Association	E. C. White
American Bankers Association	G. W. Frey
American Gas Association & Edison Electric Institute	J. A. Comerford
American Institute of Certified Public Accountants	G. B. Davis
American Library Association	H. Avram
American Newspaper Publishers Association	W. D. Rinehart
American Petroleum Institute	F. A. Gitzendanner
Association of American Railroads	C. L. Byham
Association for Computing Machinery	D. T. Ross
Association for Educational Data Systems	M. Gotterer
Business Equipment Manufacturers Association	R. Bemer
	R. F. Clippinger
	C. T. Deere
	U. C. S. Dilks
	S. Erdreich
	I. M. Gardoff
	R. W. Green
	J. A. Haddad
	P. A. Lesser
	R. J. Mindlin
	G. Poorte
	D. J. Reyen
Council of State Governments	D. G. Price
Data Processing Management Association	R. C. Elliott
Electronic Industries Association	H. H. Smith
Engineers Joint Council	W. M. Carlson
General Services Administration	M. W. Burris
Institute of Electrical and Electronics Engineers	G. W. Patterson
Insurance Accounting and Statistical Association	J. Nix
International Communications Association	C. L. Hutchinson
Joint Users Group	R. E. Utman
Life Office Management Association	E. Boulanger
National Bureau of Standards	J. H. Wegstein
National Machine Tool Builders Association	E. Koschella
National Retail Merchants Association	E. Langtry
Printing Industries of America	L. P. Chvany
Scientific Apparatus Makers Association	W. B. Schultz
Systems and Procedures Association	E. Tomeski
Telephone Group	L. W. Claussen
USA Standards Committee on Office Machinery, X4	C. E. Ginder
U. S. Department of Defense	G. L. Bowlby

At the time the proposal was developed and processed through the X3.2 Subcommittee on Codes and Input-Output, the subcommittee membership was as follows:

L. L. Griffin, *Chairman*

R. Adams
John F. Auwaerter
E. A. Avakian
T. R. Bousquet
Robert M. Brown
N. Clark
C. Crandall
Robert J. Donohue
S. Erdreich
D. E. Holmes
H. R. Hoots
R. M. Ireland
M. R. Jepson
D. A. Kerr
R. Kudisch
John L. Little
C. E. Mackenzie
W. H. McKenzie
M. Mendelsohn
George L. Murphy
J. K. Nelson
H. Spielman
J. E. Taunt
R. E. Utman
E. F. Vidro, Jr.
G. E. Williams

The Task Group on Code Development, X3.2.4, which developed the proposal, had the following personnel:

John L. Little, *Chairman*

E. A. Avakian
J. B. Booth
E. H. Clamons
N. Clark
W. S. Crosby
R. J. Donohue
W. F. Emmons
S. Erdreich
E. S. Fergusson
H. R. Hoots
W. F. Huf
H. F. Ickes
D. A. Kerr
R. Kudisch
C. N. Mooers
J. K. Nelson
H. Spielman
L. R. Turner
E. F. Vidro, Jr

It should be recognized that although X3.2 and X3.2.4 members are variously affiliated, work on a subcommittee or task group is achieved primarily on an individual competence and experience basis.

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USA Standard Code
for Information Interchange

1. Scope

This coded character set is to be used for the general interchange of information among information processing systems, communication systems, and associated equipment.

2. Standard Code

Bits				b7 b6 b5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → ROW ↓	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	´	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	¦
1	1	0	1	13	CR	GS	–	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	___	o	DEL

3. Character Representation

The standard 7-bit character representation, with b_7 the high-order bit and b_1 the low-order bit, is shown below:

EXAMPLE: The bit representation for the character "K," positioned in column 4, row 11, is

b_7	b_6	b_5	b_4	b_3	b_2	b_1
1	0	0	1	0	1	1

The code table position for the character "K" may also be represented by the notation "column 4, row 11" or alternatively as "4/11." The decimal equivalent of the binary number formed by bits b_7, b_6, and b_5, collectively, forms the column number, and the decimal equivalent of the binary number formed by bits b_4, b_3, b_2, and b_1, collectively, forms the row number.

4. Legend

4.1 Control Characters

NUL	Null
SOH	Start of Heading (CC)
STX	Start of Text (CC)
ETX	End of Text (CC)
EOT	End of Transmission (CC)
ENQ	Enquiry (CC)
ACK	Acknowledge (CC)
BEL	Bell (audible or attention signal)
BS	Backspace (FE)
HT	Horizontal Tabulation (punched card skip) (FE)
LF	Line Feed (FE)
VT	Vertical Tabulation (FE)
FF	Form Feed (FE)
CR	Carriage Return (FE)
SO	Shift Out
SI	Shift In
DLE	Data Link Escape (CC)
DC1	Device Control 1
DC2	Device Control 2
DC3	Device Control 3
DC4	Device Control 4 (Stop)
NAK	Negative Acknowledge (CC)
SYN	Synchronous Idle (CC)
ETB	End of Transmission Block (CC)
CAN	Cancel
EM	End of Medium
SUB	Substitute
ESC	Escape
FS	File Separator (IS)
GS	Group Separator (IS)
RS	Record Separator (IS)
US	Unit Separator (IS)
DEL	Delete[1]

NOTE: (CC) Communication Control
(FE) Format Effector
(IS) Information Separator

[1] In the strict sense, DEL is not a control character. (See 5.2.)

4.2 Graphic Characters

Column/Row	Symbol	Name
2/0	SP	Space (Normally Non-Printing)
2/1	!	Exclamation Point
2/2	"	Quotation Marks (Diaeresis[2])
2/3	#	Number Sign[3,4]
2/4	$	Dollar Sign
2/5	%	Percent
2/6	&	Ampersand
2/7	'	Apostrophe (Closing Single Quotation Mark; Acute Accent[2])
2/8	(	Opening Parenthesis
2/9	)	Closing Parenthesis
2/10	*	Asterisk
2/11	+	Plus
2/12	,	Comma (Cedilla[2])
2/13	-	Hyphen (Minus)
2/14	.	Period (Decimal Point)
2/15	/	Slant
3/10	:	Colon
3/11	;	Semicolon
3/12	<	Less Than
3/13	=	Equals
3/14	>	Greater Than
3/15	?	Question Mark
4/0	@	Commercial At[3]
5/11	[	Opening Bracket[3]
5/12	\	Reverse Slant[3]
5/13	]	Closing Bracket[3]
5/14	^	Circumflex[2,3]
5/15	_	Underline
6/0	`	Grave Accent[2,3] (Opening Single Quotation Mark)
7/11	{	Opening Brace[3]
7/12	¦	Vertical Line[3]
7/13	}	Closing Brace[3]
7/14	~	Overline[3] (Tilde[2]; General Accent[2])

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[2] The use of the symbols in 2/2, 2/7, 2/12, 5/14, 6/0, and 7/14 as diacritical marks is described in Appendix A, A5.2.

[3] These characters should not be used in international interchange without determining that there is agreement between sender and recipient. (See Appendix B4.)

[4] In applications where there is no requirement for the symbol #, the symbol £ may be used in position 2/3.

5. Definitions

5.1 General

(CC) Communication Control: A functional character intended to control or facilitate transmission of information over communication networks.

(FE) Format Effector: A functional character which controls the layout or positioning of information in printing or display devices.

(IS) Information Separator: A character which is used to separate and qualify information in a logical sense. There is a group of four such characters, which are to be used in a hierarchical order.

5.2 Control Characters

NUL (Null): The all-zeros character which may serve to accomplish time fill and media fill.

SOH (Start of Heading): A communication control character used at the beginning of a sequence of characters which constitute a machine-sensible address or routing information. Such a sequence is referred to as the "heading." An STX character has the effect of terminating a heading.

STX (Start of Text): A communication control character which precedes a sequence of characters that is to be treated as an entity and entirely transmitted through to the ultimate destination. Such a sequence is referred to as "text." STX may be used to terminate a sequence of characters started by SOH.

ETX (End of Text): A communication control character used to terminate a sequence of characters started with STX and transmitted as an entity.

EOT (End of Transmission): A communication control character used to indicate the conclusion of a transmission, which may have contained one or more texts and any associated headings.

ENQ (Enquiry): A communication control character used in data communication systems as a request for a response from a remote station. It may be used as a "Who Are You" (WRU) to obtain identification, or may be used to obtain station status, or both.

ACK (Acknowledge): A communication control character transmitted by a receiver as an affirmative response to a sender.

BEL (Bell): A character for use when there is a need to call for human attention. It may control alarm or attention devices.

BS (Backspace): A format effector which controls the movement of the printing position one printing space backward on the same printing line. (Applicable also to display devices.)

HT (Horizontal Tabulation): A format effector which controls the movement of the printing position to the next in a series of predetermined positions along the printing line. (Applicable also to display devices and the skip function on punched cards.)

LF (Line Feed): A format effector which controls the movement of the printing position to the next printing line. (Applicable also to display devices.)

VT (Vertical Tabulation): A format effector which controls the movement of the printing position to the next in a series of predetermined printing lines. (Applicable also to display devices.)

FF (Form Feed): A format effector which controls the movement of the printing position to the first predetermined printing line on the next form or page. (Applicable also to display devices.)

CR (Carriage Return): A format effector which controls the movement of the printing position to the first printing position on the same printing line. (Applicable also to display devices.)

SO (Shift Out): A control character indicating that the code combinations which follow shall be interpreted as outside of the character set of the standard code table until a Shift In character is reached.

SI (Shift In): A control character indicating that the code combinations which follow shall be interpreted according to the standard code table.

DLE (Data Link Escape): A communication control character which will change the meaning of a limited number of contiguously following characters. It is used exclusively to provide supplementary controls in data communication networks.

DC1, DC2, DC3, DC4 (Device Controls): Characters for the control of ancillary devices associated with data processing or telecommunication systems, more especially switching devices "on" or "off." (If a single "stop" control is required to interrupt or turn off ancillary devices, DC4 is the preferred assignment.)

NAK (Negative Acknowledge): A communication control character transmitted by a receiver as a negative response to the sender.

SYN (Synchronous Idle): A communication control character used by a synchronous transmission system in the absence of any other character to provide a signal from which synchronism may be achieved or retained.

ETB (End of Transmission Block): A communication control character used to indicate the end of a block of data for communication purposes. ETB is used for blocking data where the block structure is not necessarily related to the processing format.

CAN (Cancel): A control character used to indicate that the data with which it is sent is in error or is to be disregarded.

EM (End of Medium): A control character associated with the sent data which may be used to identify the physical end of the medium, or the end of the used, or wanted, portion of information recorded on a medium. (The position of this character does not necessarily correspond to the physical end of the medium.)

SUB (Substitute): A character that may be substituted for a character which is determined to be invalid or in error.

5. Definitions

5.1 General

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NUL (Null): The all-zeros character which may serve to accomplish time fill and media fill.

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HT (Horizontal Tabulation): A format effector which controls the movement of the printing position to the next in a series of predetermined positions along the printing line. (Applicable also to display devices and the skip function on punched cards.)

LF (Line Feed): A format effector which controls the movement of the printing position to the next printing line. (Applicable also to display devices.)

VT (Vertical Tabulation): A format effector which controls the movement of the printing position to the next in a series of predetermined printing lines. (Applicable also to display devices.)

FF (Form Feed): A format effector which controls the movement of the printing position to the first predetermined printing line on the next form or page. (Applicable also to display devices.)

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EM (End of Medium): A control character associated with the sent data which may be used to identify the physical end of the medium, or the end of the used, or wanted, portion of information recorded on a medium. (The position of this character does not necessarily correspond to the physical end of the medium.)

SUB (Substitute): A character that may be substituted for a character which is determined to be invalid or in error.

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ESC (Escape): A control character intended to provide code extension (supplementary characters) in general information interchange. The Escape character itself is a prefix affecting the interpretation of a limited number of contiguously following characters.

FS (File Separator), GS (Group Separator), RS (Record Separator), and US (Unit Separator): These information separators may be used within data in optional fashion, except that their hierarchical relationship shall be: FS is the most inclusive, then GS, then RS, and US is least inclusive. (The content and length of a File, Group, Record, or Unit are not specified.)

DEL (Delete): This character is used primarily to "erase" or "obliterate" erroneous or unwanted characters in perforated tape. (In the strict sense, DEL is not a control character.)

5.3 Graphic Characters

SP (Space): A normally non-printing graphic character used to separate words. It is also a format effector which controls the movement of the printing position, one printing position forward. (Applicable also to display devices.)

6. General Considerations

6.1 This standard does not define the means by which the coded set is to be recorded in any physical medium, nor does it include any redundancy or define techniques for error control. Further, this standard does not define data communication character structure, data communication formats, code extension techniques, or graphic representation of control characters.

6.2 Deviations from the standard may create serious difficulties in information interchange and should be used only with full cognizance of the parties involved.

6.3 The relative sequence of any two characters, when used as a basis for collation, is defined by their binary values.

6.4 No specific meaning is prescribed for any of the graphics in the code table except that which is understood by the users. Furthermore, this standard does not specify a type style for the printing or display of the various graphic characters. In specific applications, it may be desirable to employ distinctive styling of individual graphics to facilitate their use for specific purposes as, for example, to stylize the graphics in code positions 2/1 and 5/14 into those frequently associated with logical OR (|) and logical NOT (¬), respectively.

6.5 The appendixes to this standard contain additional information on the design and use of this code.

Appendixes

(These Appendixes are not a part of USA Standard Code for Information Interchange, X3.4-1967, but are included to facilitate its use.)

Appendix A

Design Considerations for the Coded Character Set

A1. Introduction

The standard coded character set is intended for the interchange of information among information processing systems, communication systems, and associated equipment.

A2. Considerations Affecting the Code

There were many considerations that determined the set size, set structure, character selection, and character placement of the code. Among these were (not listed in order of priority):

(1) Need for adequate number of graphic symbols
(2) Need for adequate number of device controls, format effectors, communication controls, and information separators
(3) Desire for a non-ambiguous code, i.e., one in which every code combination has a unique interpretation
(4) Physical requirements of media and facilities
(5) Error control considerations
(6) Special interpretation of the all-zeros and all-ones characters
(7) Ease in the identification of classes of characters
(8) Data manipulation requirements
(9) Collating conventions
    (a) Logical
    (b) Historical
(10) Keyboard conventions
    (a) Logical
    (b) Historical
(11) Other set sizes
(12) International considerations
(13) Programming languages
(14) Existing coded character sets.

A3. Set Size

A 7-bit set is the minimum size that will meet the requirements for graphics and controls in applications involving general information interchange.

A4. Set Structure

A4.1 In discussing the set structure it is convenient to divide the set into 8 columns and 16 rows as indicated in this standard.

A4.2 It was considered essential to have a dense subset which contained only graphics. For ease of identification this graphic subset was placed in six contiguous columns.

A4.3 The first two columns were chosen for the controls for the following three reasons:

(1) The character NUL by its definition has the location 0/0 in the code table. NUL is broadly considered a control character.

(2) The representations in column 7 were felt to be most susceptible to simulation by a particular class of transmission error—one which occurs during an idle condition on asynchronous systems.

(3) To permit the considerations of graphic subset structure described in A6 to be satisfied, the two columns of controls had to be adjacent.

A4.4 The character set was structured to enable the easy identification of classes of graphics and controls.

A5. Choice of Graphics

A5.1 Included in the set are the numerals 0 through 9, upper and lower cases of the alphabetic letters A through Z, and those punctuation, mathematical, and business symbols considered most useful. The set includes a number of characters commonly encountered in programming languages. In particular, all the COBOL and FORTRAN graphics are included.

A5.2 In order to permit the representation of languages other than English, one diacritical (or accent) mark has been included, and provision has been made for the use of five punctuation symbols alternately as diacritical marks. The pairing of these punctuation symbols with their corresponding diacritical marks was done to facilitate the design of a typeface which would be acceptable for both uses.

These arrangements are:

Col/Row	Code Table Symbol	Use	
		Punctuation	Diacritical
2/2	"	Quotation Marks	Diaeresis
2/7	´	Apostrophe	Acute Accent
2/12	,	Comma	Cedilla
5/14	^	(None)	Circumflex
6/0	`	Opening Single Quotation Mark	Grave Accent
7/14	~	Overline	Tilde*

*May also be used for other accents not specifically provided.

A5.3 The character *overline* is shown as it is in the code table to suggest a means of avoiding confusion with *underline*, and to reflect its use as *tilde*. The character *vertical line* is shown as it is in the code table to avoid confusion with the solid vertical bar frequently used as a logical operator, which may be found in some systems as a graphic stylization of *exclamation point*.

A6. Graphic Subset Structure

A6.1 The basic structure of the dense graphic subset was influenced by logical collating considerations, the requirements of simply related 6-bit sets, and the needs of typewriter-like devices. For information processing, it is desirable that the characters be arranged in such a way as to minimize both the operating time and the hardware components required for ordering and sequencing operations. This requires that the relative order of characters, within classes, be such that a simple comparison of the binary codes will result in information being ordered in a desired sequence.

A6.2 Conventional usage requires that SP *(space)* be ahead of any other symbol in a collatable set. This permits a name such as "JOHNS" to collate ahead of a name such as "JOHNSON." The requirement that punctuation symbols such as *comma* also collate ahead of the alphabet ("JOHNS, A" should also collate before "JOHNSON") establishes the special symbol locations, including SP, in the first column of the graphic subset.

A6.3 To simplify the design of typewriter-like devices, it is desirable that there be only a common 1-bit difference between characters to be paired on keytops. This, together with the requirements for a contiguous alphabet, and the collating requirements outlined above, resulted in the placement of the alphabet in the last four columns of the graphic subset and the placement of the numerals in the second column of the graphic subset.

A6.4 It is expected that devices having the capability of printing only 64 graphic symbols will continue to be important. It may be desirable to arrange these devices to print one symbol for the bit pattern of both upper and lower case of a given alphabetic letter. To facilitate this, there should be a single bit difference between the upper and lower case representations of any given letter. Combined with the requirement that a given case of the alphabet be contiguous, this dictated the assignment of the alphabet, as shown, in columns 4 through 7.

A6.5 To minimize ambiguity caused by the use of a 64-graphic device as described above, it is desirable, to the degree possible, that each character in column 6 or 7 differ little in significance from the corresponding character in column 4 or 5. In certain cases, this was not possible.

A6.6 The assignment of *reverse slant* and *vertical line*, the *brackets* and *braces*, and *circumflex* and *overline* were made with a view to the considerations of A6.5.

A6.7 The resultant structure of "specials" (S), "digits" (D), and "alphabetics" (A) does not conform to the most prevalent collating convention (S-A-D) because of other more demanding code requirements.

A6.8 The need for a simple transformation from the set sequence to the prevalent collating convention was recognized, and dictated the placement of some of the "specials" within the set. Specifically, those special symbols, viz., *ampersand* (&), *asterisk* (*), *comma* (,), *hyphen* (-), *period* (.), and *slant* (/), which are most often used as identifiers for ordering information and which normally collate ahead of both the alphabet and the numerals, were not placed in the column containing the numbers, so that the entire numeric column could be rotated via a relatively simple transformation to a position higher than the alphabet. The sequence of the aforementioned "specials" was also established to the extent practical to conform to the prevalent collating convention.

A6.9 The need for a useful 4-bit numeric subset also played a role in the placement of characters. Such a 4-bit subset, including the digits and the symbols *asterisk*, *plus* (+), *comma*, *hyphen*, *period*, and *slant*, can easily be derived from the code.

A6.10 Considerations of other domestic code sets, including the Department of Defense former standard 8-bit data transmission code ("Fieldata"-1961), as well as international requirements, played an important role in deliberations that resulted in the code. The selection and grouping of the symbols *dollar sign* ($), *percent* (%), *ampersand* (&), *apostrophe* ('), *less than* (<), *equals* (=), and *greater than* (>) facilitate contraction to either a business or scientific 6-bit subset. The position of these symbols, and of the symbols *comma*, *hyphen*, *period*, and *slant*, facilitates achievement of commonly accepted pairing on a keyboard. The historic pairing of *question mark* and *slant* is preserved and the *less than* and *greater than* symbols, which have comparatively low usage, are paired with *period* and *comma* so that in dual-case keyboard devices where it is desired to have *period* and *comma* in both cases, the *less than* and *greater than* symbols are the ones displaced. Provision was made for the accommodation of alphabets containing more than 26 letters and for 6-bit contraction by the location of low-usage characters in the area following the alphabet. In addition, the requirement for the digits 10 and 11 used in sterling monetary areas was considered in the placement of the *asterisk, plus, semicolon,* and *colon,* so that the 10 and 11 could be substituted for the *semicolon* and *colon.*

A7. Control Subset Content and Structure

A7.1 The control characters included in the set are those required for the control of terminal devices, input and output devices, format, or communication transmission and switching on a general enough basis to justify inclusion in a standard set.

A7.2 Many control characters may be considered to fall into the following categories:

(1) Communication Controls
(2) Format Effectors
(3) Device Controls
(4) Information Separators.

To the extent practical controls of each category were grouped in the code table. The structure chosen also facilitates the contraction of the set to a logically related 6-bit set.

A7.3 The information separators (FS, GS, RS, US) identify boundaries of various elements of information, but differ from punctuation in that they are primarily intended to be machine sensible. They were arranged in accordance with an expected hierarchical use, and the lower end of the hierarchy is contiguous in binary order with SP (space) which is sometimes used as a machine-sensible separator. Subject to this hierarchy the exact nature of their use within data is not specified.

A7.4 The character SYN (Synchronous Idle) was located so that its binary pattern in serial transmission was unambiguous as to character framing, and also to optimize certain other aspects of its communication usage.

A7.5 ACK (Acknowledge) and NAK (Negative Acknowledge) were located so as to gain the maximum practical protection against mutation of one into the other by transmission errors.

Appendix B

Notes on Application

B1. Introduction

B1.1 The standard code was developed to provide for information interchange among information processing systems, communications systems, and associated equipment. In a system consisting of equipment with several local or native codes, maximum flexibility will be achieved if each of the native codes is translated to the standard whenever information interchange is desired.

B1.2 Within any particular equipment, system, or community of activity, it may be necessary to substitute characters. For example, some systems may require special graphic symbols and some devices may require special control codes. (Design efforts on the standard code included consideration of these types of adaptations.) So-called "secular sets" produced by such substitutions, although not conforming to this standard, may nonetheless be consonant with it if substitutions are made in accordance with the guidelines of B2.

B2. Character Substitutions

B2.1 Any character substitution will result in a coded character set which does not conform to this standard.

B2.2 It is recommended that when a character is substituted in the code table for a standard character, the standard character should not be reassigned elsewhere in the table. Such a substitute character, once assigned, should not be subsequently reassigned elsewhere.

B2.3 It is recommended that graphic substitutions be made only in the graphic area and control substitutions only in the control area. Any substitution involving a control should be made only with full cognizance of all possible operational effects.

B2.4 It should be noted that this standard specifies, for each position of the code table, the information represented by the character and not necessarily the precise action taken by the recipient when the character is received. In the case of graphics, considerable variation in the actual shape printed or displayed may be appropriate to different units, systems, or fields of application. In the case of controls, the action performed is dependent upon the use for which the particular system is intended, the application to which it is being put, and a number of conventions established by the user or designer—some system-wide and some unique to a particular unit.

B2.5 Typical examples of diversity in execution not necessarily contrary to this standard are:

(1) A number of graphic symbols, other than that used in the code table, are used for *ampersand* in various type styles; still other symbols may be more appropriate to electronic display devices. The use of such alternate symbols does not in itself constitute deviation from the standard as long as *ampersand* is the concept associated with the character. Note that this does not necessarily restrict the use of such an alternate symbol design to mean "*and*"; in any type style *ampersand* may, of course, be used with arbitrary meaning.

(2) A card punch in one application may "skip" when the character HT (Horizontal Tabulation: used as skip) is presented to it; in another application the character HT may be recorded in the card without further action.

B3. Related Larger and Smaller Sets

Consideration has been given to the relationship between the standard set and sets of other sizes. A number of straightforward logical transformations are possible which result in a variety of sets related to the standard. None of the transformed sets are recognized by this standard.

B4. International Considerations

This standard conforms to the anticipated recommendations of the International Organization for Standardization (ISO) and the International Telegraph and Telephone Consultative Committee (CCITT)* for a 7-bit code. It includes all the character assignments specified by those bodies for international standardization. Their recommendations, however, permit national standardization by the various countries in seven code table positions. Also, the characters in three additional positions have been designated as being replaceable by national characters in only those countries having an extraordinary requirement in this regard.

The seven national usage positions and their assignments in this standard are shown in the following, as well as the three "supplementary" positions, which are shown in parentheses:

Column/Row	Character (U.S.)
4/0	@
5/11	[
5/12	\
5/13	]
(5/14	`)
(6/0	´)
7/11	{
7/12	¦
7/13	}
(7/14	~)

In international interchange of information these 10 characters should not be used except where it is determined that there is agreement between sender and recipient.

In addition, in other countries, the number sign (#) (in position 2/3) may be replaced by "£".

B5. Communications Considerations

Certain control characters are designated as "communication controls." They are:

SOH	(Start of Heading)
STX	(Start of Text)
ETX	(End of Text)
EOT	(End of Transmission)
ENQ	(Enquiry)
ACK	(Acknowledge)
DLE	(Data Link Escape)
NAK	(Negative Acknowledge)
SYN	(Synchronous Idle)
ETB	(End of Transmission Block)

These may be used by communication systems for their internal signaling, or for the exchange of information relating to the control of the communication system between that system and its end terminals. Some such systems may impose restrictions on the use of these communication control characters by the end terminals. For example, the use of some of them may be completely prohibited while others may be restricted to use in conformity with the formats and procedures required by the communication system for its operation.

Appendix C

Original Criteria

C1. Introduction

C1.1 This Appendix contains the original criteria upon which the design of the code was based. Not all criteria have been entirely satisfied. Some are conflicting, and the characteristics of the set represent accepted compromises of these divergent criteria.

C1.2 The criteria were drawn from communication, processing, and media recording aspects of information interchange.

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*An international body which establishes standards and conventions for international telecommunications, especially where the public telegraph and telephone services are governmentally owned and operated. Their recommendations are often embodied in the regulations applying to such services.

C2. Criteria

C2.1 Every character of the code set shall be represented by the same number of bits (i.e., binary digits).

C2.2 The standard set shall be so structured as to facilitate derivation of logically related larger or smaller sets.

C2.3 In a code of n bits, all possible 2^n patterns of ones and zeros will be permitted and considered valid.

C2.4 The number of bits, n, shall be sufficient to provide for the alphabetic and numeric characters, commonly used punctuation marks, and other special symbols, along with those control characters required for interchange of information.

C2.5 The numerals 0 through 9 shall be included within a 4-bit subset.

C2.6 The numerals 0 through 9 shall be so represented that the four low-order bits shall be the binary-coded-decimal form of the particular numeral that the code represents. In the selection of the two characters immediately succeeding the numeral 9, consideration shall be given to their replacement by the graphics 10 and 11 to facilitate the adoption of the code in the sterling monetary area.

C2.7 The interspersion of control characters among the graphic characters shall be avoided. The characters devoted to controls shall be easily separable from those devoted to graphics.

C2.8 Within the standard set, each character shall stand by itself and not depend on surrounding characters for interpretation.

C2.9 An entire case of the alphabet (A through Z) shall be included within a 5-bit subset. Consideration shall be given to the need for more than 26 characters in some alphabets.

C2.10 The letters of each case of the alphabet shall be assigned, in conventional order (A through Z), to successive, increasing binary representations.

C2.11 Suitable control characters required for communication and information processing shall be included.

C2.12 Escape functions that provide for departures from the standard set shall be incorporated.

C2.13 A simple binary comparison shall be sufficient to determine the order within each class of characters. (In this regard, the special graphics, the numerals, and the alphabet are each defined as distinct classes.) Simple binary rules do not necessarily apply between classes when ordering information.

C2.14 Space (i.e., the space between words) must collate ahead of all other graphics.

C2.15 Special symbols used in the ordering of information must collate ahead of both the alphabet and the numerals.

C2.16 Insofar as possible, the special symbols shall be grouped according to their functions; for example, punctuation and mathematical symbols. Further, the set shall be so organized that the simplest possible test shall be adequate to distinguish and identify the basic alphabetic, numeric, and special symbol subsets.

C2.17 Special symbols shall be placed in the set so as to simplify their generation by typewriters and similar keyboard devices This criterion means, in effect, that the codes for pairs of characters that normally appear on the same keytops on a typewriter shall differ only in a common single-bit position.

C2.18 The set shall contain the graphic characters of the principal programming languages.

C2.19 The codes for all control characters shall contain a common, easily recognizable, bit pattern.

C2.20 The Null (000...) and Delete (111...) characters shall be provided.

Appendix D

Terminology

This Appendix is intended to clarify the sense in which certain terms are used.

Bit: Contraction of "binary digit."

Bit Pattern: The binary representation of a character.

Character: A member of a coded character set; the binary representation of such a member and its graphic symbol or control function.

Code: A system of discrete representation of a set of symbols and functions.

X4-A9.1/158

NL

X3.2/560
July 12, 1967

USA
STANDARDS INSTITUTE

United States of America Standards Institute
10 East 40th Street, New York, N.Y. 10016, USA   212 Murray Hill 3-3058

July 5, 1967

MR. L. L. GRIFFIN, Chairman X3.2 Subcommittee
National Bureau of Standards
Center for Computer Sciences
and Technology
Room B264, Building 225
Washington, D. C. 20234

Dear Len:

Subject: New Line

The X3.2 definitions of Carriage Return and Line Feed make it quite clear that entirely separate functions are intended. Nevertheless, there is a clear trend in the field of keyboard - oriented devices to adopt the so called "New Line" approach in which a single key - and preferably a single coded character - is associated with the combined Carriage Return and Line Feed operations.

In the planning of standard ASCII keyboard arrangements, X4-A9.1 supports this type of operation. Completion of our work, however, will not be possible without the existence of a specific encoding doctrine for "New Line."

In the absence of any such provisions in the present ASCII documentation, X4-A9.1 has assumed the use of the New Line coding prescribed, as an option, in the ISO 7-bit code: the function New Line is associated with the coded character Line Feed (LF) and the character Carriage Return (CR) retains its normal function.

Because of the obvious enthusiasm for the "New Line" type of operation, we urge that X3.2 treat this matter as soon as possible. We suggest, in particular, that the position of the ISO in this regard be adopted by X3.2 and promulgated in an appropriate manner.

John
J. B. BOOTH
Chairman X4-A9.1 Working Group

JBB:ALM

C31 67/1/17

BELL TELEPHONE LABORATORIES
INCORPORATED

SUBJECT: Colloquial Name for the USA Standard Code for Information Interchange

DATE: JUL 20 1967

FROM: D. A. Kerr

MEMORANDUM FOR FILE

In August of 1966 the American Standards Association was reorganized as the USA Standards Institute. At that time, the titles of all former American Standards were changed to "USA Standard . . . ", and the same format is of course to be used for all new standards promulgated by the institute.

During the development of the Standard Code for Information Interchange, the code itself and the embodying document were referred to by the acronym of the formal title, ASCII - American Standard Code for Information Interchange. This practice is quite common in ASA/USASI internal papers. Most such acronyms fade from usage with the approval of a standard, with the standard being subsequently referenced by its formal title, its reference number (as PH22.15-1966), or some other colloquial name (NEC - National Electric Code). In the case of ASCII, the "internal" acronym stuck, probably because it was unusually pronounceable. (One can hardly imagine the proposed standard being referred to in casual converstation as "USASGPAKAFII").

With the change in name of the standards, there has emerged a natural tendency to adopt the acronym USASCII for the former ASCII, but this should not be construed as mandatory, since in the present context it is much more a colloquial name with which we are concerned rather than the formal, if brief, nomenclature used in Institute documentation. Correspondingly, USASI Subcommittee X3.2 has by resolution encouraged its members and others to continue, if they wish, the use of the acronym "ASCII" for the code.

The same practice is recommended for Bell Laboratories' use wherever practical. In general, the custom is to omit the article "the" when using ASCII as a noun, as in "the control characters of ASCII." Of course, the article will appear when it and the acronym modify another noun, as in "the ASCII code table."

It is further recommended that, in formal documents or those intended for general distribution, the full title be referenced along with the reference designation when the term is first introduced, as "the character set of ASCII (USA Standard Code for Information Interchange - USAS X3.4-1967).

HO-3142-DAK-GL

D. A. KERR

NMAH 310/6

CE

ELECTRONIC SYSTEMS LABORATORY
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J. FRANCIS REINTJES, Director
GEORGE C. NEWTON, Jr., Associate Director
JOHN E. WARD, Deputy Director
RICHARD A. OSBORNE, Executive Officer

X3.2/586
Sept. 8, 1967

August 29, 1967

Paul B. Goodstat
Secretary of X3
BEMA
235 East 42nd Street
New York, New York 10017

Dear Mr. Goodstat,

Doug Ross showed me your correspondence X3/73 dated 12 June 1967, asking for assistance in development of a standard for code extension of USASCII. My interest in this problem stems from our work in developing remote display terminals here at Project MAC.

Our group at MIT has built a prototype of a computer time-sharing terminal capable of operating at full phone line speeds (2000 bps) and able to plot lines as well as alphanumeric symbols. We have used USASCII as the basic code for this device but had to extend it to allow us to send line drawing information as well as the standard USASCII symbols.

In choosing a method for code extension we felt constrained by the following considerations. 1) We want to stay within USASCII as much as possible. 2) We want to be able to operate over communication links which may be sensitive to particular communication control codes of the USASCII set. 3) We want to send the data as fast as possible i.e. highly coded. 4) Our terminal device should be low cost, thus our coding scheme should be very simple.

To optimize the speed of transmission and to simplify our terminal decoding we chose to send graphic (line drawing) information as binary data imbedded into USASCII. To meet considerations 1) and 2) we chose to use 6 bit binary bytes (bit 7 always a 1 in a binary character) rather than 8 bit bytes. We felt this also gained us a measure of error detection and recovery since it allows parity check and control codes retain a

CBI 67/1/16

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RICHARD A. OSBORNE, Executive Officer

single meaning.

To further enhance our speed we chose to run the machine in a mode-control manner. There are two principal modes, Symbol mode and Binary mode. In Symbol mode the display performs like a teletypewriter. Characters are interpreted as defined in USASCII with the exception of GS, RS, and US each of which causes the device to enter Binary mode. Within Binary mode there are many possible submodes. GS puts the unit in the Set Point plotting submode where it treats sequences of 4 succeeding binary characters (24 data bits) as data for plotting points in absolute locations on the screen. RS puts the unit into Extended Vector mode where it interprets sequences of 4 succeeding binary characters (24 bits) as data for plotting vectors relative to the present beam position. US causes the machine to enter Short Vector submode where sequences of 2 succeeding binary characters (12 bits) are treated as data for plotting short vectors relative to the present beam location.

Once in binary mode all codes with bit 7 = 1 are interpreted as binary data (arguments of the mode). Control codes (bit 7 = 0, bit 6 = 0) except GS, RS, and US cause the machine to revert to Symbol mode and act upon the code. The remaining characters (bit 7 = 0, bit 6 = 1) are called Key characters and are reserved for added submode control. If the machine receives a Key character at a time it is expecting a binary character (data), it enters the new mode specified by the Key and clears its registers for the new mode (i.e. it ignores any partial data received from the last mode).

As yet we have not defined meanings for any Key characters, so we have effectively 32 unused codes for new submodes. If a machine is put into a submode to which it does not respond, it simply ignores any binary characters until it is switched to a new mode. Thus submodes may have any number of binary bits of argument and we do not have to specify this number until the submode is defined. We envision using the Key characters to define modes for controlling auxiliary equipment, multiplexing control, modifying pictures parts (e.g. blink, dashed lines), cursor control, etc. I hesitate at this time to try to list all the possible functions we might like to have for our Key character definitions. Our main purpose in having submodes with arbitrary arguments (binary characters) is to provide a very large set of code extensions. We chose to keep GS, RS, and US as direct entries into submodes from Symbol mode because we use Set Point, Extended Vectors and Short Vectors very often and do not want to pay the

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price of having to send two characters to enter these submodes. (Note that entering any other submode from Symbol mode requires entering one of these three submodes first and then entering the desired submode.)

Our approach is not particularly designed for universal acceptance but we feel it is efficient and flexible for computer driven display terminals. We should feel badly if the USASCII committee were to adopt a standard that did not provide these features.

I hope that this information is the kind you are seeking and that it will be of some value to you. I would be very interested to be kept abreast of the committees progress in this delicate field of code extensions. I think it is a very appropriate area for efforts towards standards but I certainly do not envy the committee their job. If I can be of any service please feel free to call.

Thank you for your attention.

Very truly yours,

Robert H. Stotz

Robert Stotz

cc: Mr. J. Ward

RS/maf

NL

X3.2/587
Sept. 14, 1967

Compatibility Considerations of Carriage Return Line Feed Versus New Line Function in Information Processing Systems

L. L. Griffin
Sept. 12, 1967

I. Introduction

1. The X3.2 Subcommittee, at the request of Committee X4-A9.1 (USASCII Keyboard) is preparing to discuss the inclusion in the USASCII code table of a "New Line" character as an optional choice in lieu of the two character sequence, Carriage Return - Line Feed. It has been suggested that this inclusion should be the same as in the ISO 6- and 7-Bit Code. The ISO code table has a footnote which equates New Line, when used in the 7-bit code table, with code position 0/10 (Line Feed). The note also states that "New Line" is not allowed for international transmission on general communication networks.

2. A searching examination of the effect on interchange compatibility of allowing two different end of line character sequences, e.g. "Carriage Return" - "Line Feed" and "New Line", is in order. In this paper, an attempt will be made to examine the compatibility question from the standpoint of a large user organization.

II. Background

3. Electromechanical teletypewriter like devices require a period of time after receipt of CR-LF or New Line code to reposition the typing mechanism to the left hand margin. When separate function codes are used, the CR code is transmitted first followed by the LF code. Hence, the carriage is returning during the period when the paper is being advanced to the next printing line. In some systems, the operating procedures call for one or more redundant characters in order to provide an additional time margin of safety. For example, the Department of Defense communication system procedures prescribe CR-CR-LF at the end of each line. A well established convention in many teletypewriter networks is the use of CR-LF-Letters at the end of each line. The important point is that teletypewriters, in general, require a time greater than one character time to return to the left hand margin and stabilize in position for printing the first character of the next line.

4. When a single code, "New Line" is used in lieu of CR-LF codes, time must be allowed for the carriage to return before the teletypewriter is required to respond to printing character codes.

CBI 67/1/16

5. Electronic display type terminal devices do not have the time limitations of mechanical devices, hence there is not a requirement for "time fill" after receipt of a "New Line" function before "display" on the next line can begin.

6. Terminal devices which provide remote access to computers for various purposes are growing in popularity. A number of different makes and models of terminals may have access to a single computer or computer controlled file. Conversely, a single terminal may have access to more than one computer or computer controlled file.

7. Communication networks and computers are being combined in many organizations into an information processing system which serves both data processing and message communication purposes. A single terminal device may serve both for access to computer systems as well as for sending and receiving conventional messages.

III. Discussion

8. It seems most probable that many large information processing systems of the future will employ a variety of terminal teletypewriters and that these teletypewriters will, in many cases, be multipurpose terminals. The use of CR-LF on some terminal teletypewriters and NL on others seems to generate unnecessary and costly incompatibility problems in such a system. The same message, for instance, may be addressed to a number of terminals. Hence, a common procedure is at least highly desirable. Within an organization, it may be prudent to prescribe, as a matter of policy, a single end-of-line character sequence to which all teletypewriter terminals must adhere. The primary reasons for such a policy being assurance of company-wide compatibility, since it is difficult to define the future limits of systems or the requirements of information interchange between systems. The Federal Government, for instance, might adopt a Federal standard which prescribes one end-of-line character sequence.

9. The fact that a computer can be programmed to insert "time fill" characters after a N.L. code is sometimes cited as a method used to provide time for the carriage to complete the return. This does not solve the problem of "time fill" when no computer is involved, as, for instance, when used as a communication system terminal. Furthermore, computers often function in a forwarding, or relay, capacity and should not be required to scan texts for insertion of function codes such as "time fill".

10. Since mechanical teletypewriters do require time to "return" the carriage, no time advantage seems to be gained by the use of N.L. If the operator is required to follow the N.L. key stroke with a time fill key stroke, no operator advantage seems to be gained by the use of N.L. in lieu of CR-LF.

11. Cathode ray tube display devices do not have the "time fill" requirement of mechanical devices. Nevertheless, it may be advantageous to use a common end-of-line character sequence on all keyboard terminal devices for such reasons as the following:

    a. Uniform operator training and practices.

    b. Compatible procedures for intercommunication between display and mechanical devices as well as from computer to terminals.

    c. Uniformity and, hence, simplicity of computer input-output to remote terminal operating system software.

IV. Conclusions

12. In order to obtain systems compatibility, a single end-of-line character sequence should be prescribed for use with all teletypewriter terminals throughout a system.

13. In view of the "time fill" requirement of mechanical devices, it is not evident that "New Line" offers advantages over "Carriage Return - Line Feed" as an end-of-line character sequence.

14. Significant compatibility advantages may also be gained if a common procedure is applied to both teletypewriter and electronic character display terminals.

CE X3.2/592

September 18, 1967

MEMBERS USASI X3.2 AND X3.2.4

I am in receipt of R. W. Bemer's paper on the subject of X3.2.4's work on code extension. As a principal author of the relevant document, X3.2.4/208, I would like to comment on his remarks.

The subject paper is based upon the premise that X3.2.4 is on the wrong track: that they are not using Escape for the purpose for which Mr. Bemer "invented" it.

Consider, however, that X3.2.4 began its deliberations on the subject of code extension, 5 years ago, with the first objective of isolating a class of problems whose solution seemed most useful for the foreseeable future. The group pursued this topic at length (without regular access to the thoughts of Mr. Bemer) and, in an admittedly somewhat arbitrary way, selected such a class. This did not limit itself to the entry of a system into other "code sheets" for extended periods - though that is accommodated - but treated the general representation, on an ad hoc basis, of additional control characters. The proposed doctrine was chosen to provide an acceptably high level of efficiency in those environments which we can now understand.

This admittedly arbitrary identification of the job to be done indeed differs from the view originally conceived by Mr. Bemer.

Unfortunately, Mr. Bemer's proposed doctrine gives no convenient means of giving machine commands not directly represented in ASCII. It would require at least 5 characters to encode a single such control function as contrasted by the 2 character minimum admitted by X3.2.4. Yet the X3.2.4 doctrine still allows the assignment of any desired number of escape sequences to the selection of additional "code sheets", the function for which Mr. Bemer sees a need.

As in all other aspects of code extension standardization X3.2.4 has attempted to accommodate differing needs, since no single problem can be identified as being uniquely worthy of solution.

With regard to the implementation of the proposed doctrine in "cheap" terminals, I hasten to point out that the recognition of the extent of the sequence can even be easily done in many present electromechanical terminal designs for very

CBI 67/1/16

modest cost. This ability requires no buffering in the usual sense. With regard to recognition of a sequence for action, designers of simpler systems can minimize the lengths of all sequences to be assigned for use, a capability intentionally given by the proposed doctrine.

Concerning the "spelling" of certain sequences in programming languages, there seems to be no more justification to represent such mnemonic operators by escape sequences than to insist that there be characters in ASCII for "DOG" and "CAT". The fact that people can do some unwarranted things and still not violate the doctrine seems hardly relevant.

With respect to SO and SI, the complaint that "the SO set" is not defined fails to recognize the fundamental need for standard and parochial (i.e., local) character sets to coexist within the same hardware, with an easy means of transfer between them. This view is clearly stated in X3.2.4/208, and it is curious that Mr. Bemer chooses to ignore it rather than to rebut it. Based on this view, X3.2.4 did not intend to define the SO set.

Mr. Bemer's observations on the relationship between SO and SI, and the use of Escape sequences as additional "shifts" - the only use he recognizes - is quite in accord with document X3.2.4/208.

Finally, the significance of Mr. Bemer's point (3) - "That the proposed doctrine is untested in theory by any simulation or modeling" - eludes me. The members of X3.2.4 have tested the proposed doctrine against many possible applications, and naturally have formed various opinions of its utility in each. The use of the phrase "simulation or modeling" seems to impute to the proposed doctrine a sense of esoteric complexity not at all consistent with the straightforward nature of the doctrine itself.

D. A. KERR
Member X3.2, X3.2.4

Copy to
Messrs. R. W. Bemer
P. B. Goodstat
G. E. Willibald

Colloquial Name for USAS X3.4

/503

BELL TELEPHONE LABORATORIES
INCORPORATED
HOLMDEL, NEW JERSEY
TELEPHONE
AREA CODE 201
949-3000

MEMBERS USASI X3.2:

The distaste and confusion attending the emergence of the term "USASCII" causes me to review both precedents and criteria for the establishment and use of colloquial titles for Standards.

There is little, if any, precedent for the widespread usage of the acronym of the formal title of a standard, other than in the case of "ASCII". Often, the standards are referred to by some descriptive phrase or by the codument number (ASA C42, Mil-188-B, etc.) The use of an acronym has apparently had its greatest utility in the internal correspondence of standards bodies, where reference to the formal title of a new standard was appropriate to avoid ambiguity but where a shorthand form was needed. Most such acronyms are unpronounceable.

Thus, there seems little absolute need to embrace the term "USASCII" as a general term. But what instead? Were there no precedent at all, I might be tempted to suggest something like "IIC" ("Information Interchange Code", pronounced "eye-eye-see"). However, the widespread usage of the term "ASCII" makes it now attractive as a colloquial name - not as an official acronym.

I recommend that Subcommittee X3.2, by resolution, officially institute a program to encourage the use of this convention. The program could consist, in the main, merely of diligent adherence - with explanation, if needed - in all correspondence and documents issued by the various committees and their members.

'Tis a grand old name..

Very truly yours,

DAKerr

D. A. KERR
Member of X3.2,
Developers of ASCII

C31 67/2/19

X3.2/619
X3.2.4/230
November 20, 1967

To: MEMBERS USASI X3.2 AND X3.2.4

From: D. A. Kerr

Subject: Amendment to Proposed Addendum to ASCII - Formalization of Notation "ASCII".

At the February, 1967 meeting of X3.2 a resolution was approved endorsing the use of the notation "ASCII" to designate the code of USAS X3.4. I propose that, since an addendum to X3.4-1967 is under preparation, material be added establishing this recommended notation.

At the time of the resolution, and subsequently, objections have been raised which principally fall into two classes:

1. The Institute will never allow a notation to be established which is not the acronym of the title of the standard, that is, "USASCII".

2. Many people have produced documentation using the notation "USASCII" and do not wish to see it deprecated.

With regard to item 1, I felt that these fears were groundless. As a matter of fact, it is rare that the acronym of a standard's title comes into commercial usage as a designator, the original "ASCII" being perhaps the first such case. Often, a technical committee will establish many items of notation and designation for items under standardization, often based on past practice. Perhaps the most familiar example of this is the notation "ASA", recently reaffirmed by PH22 as the designation of the "USA Standard Speed", a measure of photographic film sensitivity. Informal communication with Institute personnel convince me that we will probably have no problem in this area.

With regard to item 2, I have constructed proposed wording which I feel should mitigate this problem to the point where it should no longer be of concern.

This proposed wording is contained in the attached "Proposed Amendment...", whose adoption I heartily endorse.

D. A. KERR
Member X3.2.4

Att.
As above

CBI 67/2/21

X3.2/619
X3.2.4/230
November 20, 1967

Proposed Amendment

(By D. A. Kerr)

to the

PROPOSED ADDENDUM TO USA STANDARD CODE FOR INFORMATION INTERCHANGE

(X3.4-1967)

Change title of section 3 to read:

3. Character Representation and Code Identification

Add to the end of the existing section 3:

The standard code may be identified by the use of the notation "ASCII" (pronounced as'key). The notation "USASCII" is also in common use, and should be taken to have the same significance.

The notation "ASCII" should ordinarily be taken to mean the code prescribed by the latest issue of the standard. To explicitly designate a particular (perhaps prior) issue, the last two digits of the year of issue may be appended, as "ASCII 63".

ISO

International Organization for Standardization
Organisation Internationale de Normalisation
Международная Организация по Стандартизации

CENTRAL SECRETARIAT
Telephone 34 12 40
1, rue de Varembé
1211 GENEVA 20, Switzerland
Cable address : ISORGANIZ

Our Ref. : ISO/TC 97 - COUNCIL + MB

22 December 1967

TO THE MEMBERS OF THE COUNCIL
AND TO ALL THE ISO MEMBER BODIES

Gentlemen,

ISO/TC 97 - COMPUTERS AND INFORMATION PROCESSING

ACCEPTANCE OF DRAFT ISO RECOMMENDATION No. 1052

With reference to the circular letter we sent you on 21 July 1967, we take pleasure in informing you that the ISO Council has just decided, by correspondence, to accept as an ISO Recommendation the Draft ISO Recommendation No. 1052 (document 97 N 159).

The Draft is accepted by 12 votes to 1 vote.

The vote of 1 Council Member had not reached the Central Secretariat at the date of this circular letter (Bulgaria).

One Council Member, Ireland, voted against acceptance of the Draft, considering that there was nothing in the final report to show that the objections raised by Member Bodies had been adequately considered and that the reasons for not meeting the objections raised had not been stated.

The comments put forward by Ireland were communicated to both the Secretariat of Sub-Committee ISO/TC 97/SC 2, which had formulated the Draft, and to the Secretariat of the full Committee.

AFNOR, in its capacity as Secretariat of Sub-Committee 2 has indicated that, in view of the overwhelming majority voting in favour of the Draft, the ISO/TC 97 Editing Committee, which examined the comments, decided to handle only those comments affecting form and not those having a bearing on substance, considering that the technical discussions were closed. This reply of the ISO/TC 97/SC 2 Secretariat was immediately transmitted to Ireland.

Further, the Secretariat of the full Committee feels the Irish comment does not warrant delaying the publication of this Recommendation, eagerly awaited in the interested circles.

The Central Secretariat has undertaken the publication of the new ISO Recommendation, registered under the following reference :

ISO/R 646-1967 - 6 and 7 bit coded character sets for information processing interchange.

Yours sincerely,

Marechal

R. Maréchal
Assistant Secretary-General

NMAH
310/6

Copy to : President
Vice-President
General Secretary IEC

Date: June 10, 1968
From (location or U.S. mail address): SDD POUGHKEEPSIE
Dept. & Bldg.: Dept. B13 - Bldg. 706-2
Telephone Ext.: 3-2141

IBM

Subject: Planned Revision to Corporate Systems Standard 2-8015-002, EBCDIC

Reference:

To: FILE

EBCDIC was approved and published in IBM in October, 1964. Since that time, a number of additions have been made, to accommodate requirements of certain products. Further, certain additions are now under review, to accommodate the requirements of the 7-Bit Code environment (ISO, ECMA, USASCII, etc.).

These additions and proposed additions are indicated in the attached "Proposed EBCDIC", by lines in the margin, and a numeric keying as follows:

①	Addition to EBCDIC of those 7-Bit Code control characters not already in EBCDIC.
②	Addition to EBCDIC of those 7-Bit Code graphics not already in EBCDIC.
③	Information on the 7-Bit Code (s), and on the Hollerith Card Code.
④	Control characters added to EBCDIC to meet certain product requirements.
⑤	Information on signed numerics
⑥	Information on packed decimals
⑦	Alphabetic Extenders
⑧	OCR-A Abstract Symbols

CMackenzie
C. E. Mackenzie

CEM:w 2
CBI 94/~~8~~/ unnumbered

Proposed May 15, 1968

EXTENDED BCD INTERCHANGE CODE

CSS Cat.	2-8015 Subject	002 Suffix

IBM Corporate Systems Standard

INTRODUCTION

1.1 SCOPE. This standard defines for the IBM Corporation the BCD coded representation for up to 256 graphics and controls in punched cards, in magnetic tape, on data transmission lines, and in 8-bit BCD CPUs. It also defines a collating sequence.

This standard includes:

a) The 256 characters Extended BCD Card Code.

b) The 256 character, 8-bit Extended BCD CPU Code.

c) The 256 character, 8-bit Extended BCD Magnetic Tape Code.

d) The 256 character, 8-bit Extended BCD Transmission Code.

e) The collating sequence for the 256 characters.

f) Control characters, graphic characters, and characters with special meaning.

g) Names for some of the characters.

h) Specific characters for use in programming products.

i) Information on the 128-character ISO 7-Bit Code, on the 128-character USA Standard Code for Information Interchange, on the 128-character Hollerith Card Code, and the correspondences of those codes to 128 characters of the 256-character 8-bit Extended BCD Interchange Code. ③

j) Information on signed numerics. ⑤

k) Information on packed decimal. ⑥

REQUIREMENTS

2.1 EXTENDED BCD CARD CODE. The 256 character, twelve-row card code is given in Column 5 of Table IV.

2.2 EXTENDED BCD CPU, TRANSMISSION, AND MAGNETIC TAPE CODE. The 8-bit, Extended BCD CPU, Transmission, and Magnetic Tape Code is given in Column 6 of Table IV.

2.2.1 Track Assignment for Magnetic Tape. The Track Numbering for 9-track, One-Half-Inch magnetic tape and for 10-track, One-Inch magnetic tape and the correspondence between this Track Assignment and the 8 bits of the Extended BCD Magnetic Tape Code (Column 6 of Table IV) is shown in Table I.

2.3 REFERENCE NUMBERS. Reference numbers for the characters are given in Columns 1, 2, 3, and 4, of Table IV.

2.3.1 Column 1 gives reference numbers for the 256 characters of this standard, running 0, 1, 2, 3, ... 255.

2.3.2. Column 2 in this standard gives reference numbers for the 64 card and magnetic tape characters specified in BCDIC. The reference numbers given in Column 2 of this standard are called "Collating Numbers" in BCDIC. It is to be noted that where the Reference Number in Column 2 of this standard matches the Collating Number of BCDIC, the card codes also match, but graphics do not always match. A 6-bit BCD magnetic tape character translates to the 8-bit BCD character whose Reference Number in Column 2, Table IV of this standard matches the Collating Number in Column 1, Table I of BCDIC.

2.3.3 Column 3 gives Reference Numbers for PTTC/EBCD for use in 8-bit Environments. It is to be noted that where the Reference Numbers in Column 3 of this standard match the Reference Numbers in Column 1 of Tables I and II of PTTC/EBCD, the card characters of this standard match the Extended Card Code characters in Column 5 of Tables I and II of PTTC/EBCD, and the graphics of Column 7 of this standard also match the Duocase Alphabet Set in Column 7 of Tables I and II of PTTC/EBCD.

2.3.4 Column 4 gives Reference Numbers for the Monocase PTTC/EBCD. It is to be noted that where the Reference Numbers in Column 4 of Table IV of this standard match the Reference Numbers in Column 1 of Tables I and II of PTTC/EBCD, the card characters of this standard match the Basic Card Code Characters in Column 4 of Tables I and II of PTTC/EBCD, and the graphics of Column 7 of this standard also match the Monocase Alphabet Set in Column 6 of Table I and II of PTTC/EBCD.

2.4 CONTROLS AND SPECIAL MEANINGS.

2.4.1 General Definitions. The control characters of EBCDIC fall into eight major classifications by function, (described below), and into a minor classification by use or not in data communications systems control (described below).

2.4.1.1 Customer Use Control Characters. These characters are used to designate a customer assigned function which may be realizable by programming but are not realizable by hardware (CU1, CU2, CU3).

2.4.1.2 Device Control Characters. These characters are used to control devices, or to control major functions of devices (PF, DC1, DC2, TM/DC3, PN, RS, DC4).

2.4.1.3 Error Control Characters. These characters are used for error control, for indicating "alarms", or for identifying or requesting identification of stations in a communications system (DEL, CAN, ENQ, ACK, BEL, NAK, SUB/CH, EO).

① ④ 2.4.1.4 Formatting (or Editing) Control Characters. These characters are used for formatting, or for editing data (HT, RLF, VT, FF, CR, NL, BS, DS, SOS, FS, LF).

2.4.1.5 Grouping Control Characters. These characters are used for grouping data or information. Depending on the actual control character, they may be at the start of data, at the end of a data-block, at the start and end of a data-block (data framing), at the end of communications control block or procedure, etc., (SOH, STX, ETX, SMM, EM, CC, IFS, IGS, IRS, IUS, ETB/EOB, EOT).

2.4.1.6 Mode Control Characters. These characters are used to set modes of operation, to change a mode of operation, or to restore a previous mode of operation (LC, SO, SI, DLE, RES, BYP, ESC/PRE, SM, UC).

2.4.1.7 Reserved Control Characters. These are characters for which a function has not yet been assigned. They are reserved for assignment of future functions.

2.4.1.8 Synchronization Control Characters. These are characters used for synchronization of communications systems, or for "synchronization" of data within a format or for synchronization of data streams with certain timing characteristics of some device functions (NUL, IL, SYN).

2.4.1.9 Communications Control Characters. These characters (which also fall into the major function classifications above) are reserved exclusively for communications control (SOH, STX, ETX, DLE, ETB/EOB, ENQ, ACK, SYN, EOT, NAK).

① ④ 2.4.1.10 7-Bit Code Control Characters. Some of the control characters of this standard are defined in the ISO recommendation for 6 and 7-Bit Coded Characters for Information Processing Interchange (ISO-7, see 3.5.1.1) and in the USA Standard Code for Information Interchange (USASCII, see 3.5.1.2). Other manufacturers may use some of these characters in their I/O devices and communication devices and may interpret the definitions differently than as defined below. Such devices are sometimes attached (by customer request) locally or remotely to our 8-bit BCD CPU's. In such cases, the possibly different interpretations of definitions may have to be recognized and handled (in programming products, for example). Caution should be particularly exercised in the interpretation of NUL, DEL, SO, SI, ESC, DLE, DC1, DC2, DC3, DC4, IFS, IGS, IRS, IUS, EM, SUB when received from or transmitted to other manufacturers' devices.

2.4.1.11 PTTC/EBCD Control Characters. Some of these control characters are defined in PTTC/EBCD environments. These include those shown in Table II. For the use of such characters in PTTC/EBCD environments, refer to Section 2.8 of CSS 2-8015-003. It is to be noted that ETB, End of Transmission Block (Reference Number 38) has been called EOB, End of Block, and that ESC, Escape (Reference Number 39) has been called PRE, Prefix, in PTTC/EBCD environments.

2.4.1.12 BCDIC Alternate Meanings. Some of the characters in the graphic section of this standard have alternate meanings when used in 6-bit BCD data processing systems. These include those shown in Table III below. For the functions and special meanings of these characters in BCDIC environments, refer to Section 8 of CSS 2-8015-001.

⑤ 2.4.1.13 Signed Numerics. In card applications and equivalent 8-bit code representations involving overpunched numerics to indicate algebraic signs, Character Numbers 192 through 201 may have the meanings Plus Zero through Plus Nine, respectively, and Character Numbers 208 through 217 may have the meanings Minus Zero through Minus Nine, ⑤ respectively. These representations are usually reserved for the low-order digit of a signed numeric field.

⑥ 2.4.1.14 Packed Decimal. In certain CPU and magnetic-recorded storage applications, each 8-bit coded character may represent two decimal digits (or one decimal digit and sign). This representation has meaning only when considered as a field of one or more such contiguous characters to be operated upon as an arithmetic quantity, and is not to be confused in application with the graphic and control characters having explicit individual meanings as given elsewhere in this standard. In this special representation: The low-order character of the field is coded as the low-order decimal digit of the arithmetic quantity (in binary-coded-decimal form) in bits 0-3, with a "sign indicator" in bits 4-7. The sign indicator is identical to the value contained in bits 0-3 of the standard 8-bit code for unsigned or signed numeric characters. (The "unsigned" sign indicator is treated as "plus"). The remaining characters of the field (from low to high order) are coded as pairs of decimal digits, in corresponding sequence. For each such pair, the high-order digit is encoded into bits 0-3, and the low-order digit into bits 4-7, of the single 8-bit character. If the decimal field contains an even number of digits, bits 0-3 of the highest order 8-bit character are encoded as "all zeros".

2.4.2 Specific Definitions. Specific definitions for the control characters are given below. A part of the definition identifies the major classification by function, and the classification by use in communications control.

2.4.2.0 NUL -- Null (Reference Number 0). A synchronization control character, with an all-zeros bit-pattern, which may serve to accomplish time and media fill.

2.4.2.1 SOH -- Start of Heading (Reference Number 1). A communication grouping control character which is used at the beginning of a sequence of characters which constitute a machine-sensible address or routing information. Such a sequence is referred to as the "heading". An STX character has the effect of terminating a heading.

① 2.4.2.2 STX -- Start of Text (Reference Number 2). A communication grouping control character which precedes a sequence of characters that is to be treated as an entity and entirely transmitted through to the ultimate destination. Such a sequence is referred to as "text". STX may be used to terminate a sequence of characters started by SOH.

2.4.2.3 ETX -- End of Text (Reference Number 3). A communication grouping control character which is used to terminate a sequence of characters started with STX and transmitted as an entity. ①

2.4.2.4 PF -- Punch Off (Reference Number 4). A device control character, which deactivates a perforated tape punch. ④

2.4.2.5 HT -- Horizontal Tab (Reference Number 5). A formatting control character which:

a) moves the printing position horizontally, left to right, to the next tab stop setting, ① ④

b) is applicable to display devices, in a manner similar to (a) above, and

c) advances a card to the next tab stop setting.

2.4.2.6 LC -- Lower Case (Reference Number 6). A mode control character which shifts the BCD Perforated Tape and Transmission Codes to the Lower Case Mode. All characters which follow this precedence character are in the Lower Case Mode until an Upper Case control character is reached. ④

2.4.2.7 DEL -- Delete (Reference Number 7). An error control character which erases characters on perforated tape (see "Note" following 2.4.2.255). ① ④

2.4.2.8 (Reference Number 8). A control character reserved for assignment of future functions.

2.4.2.9 (Reference Number 9). A control character reserved for assignment of future functions.

2.4.2.10 SMM -- Start of Manual Message (Reference Number 10). A grouping control character which identifies the start of that part of a message which is manually entered. ④

2.4.2.11 VT -- Vertical Tab (Reference Number 11). A formatting control character which:

a) moves the printing position vertically, top to bottom, to the next in a series of predetermined printing lines, and, ①

b) is applicable to display devices, in a manner similar to (a) above.

2.4.2.12 FF -- Form Feed (Reference Number 12). A formatting control character which:

a) moves the printing position vertically, top to bottom, to the first predetermined printing line on the next form or page, and,

b) is applicable to display devices, in a manner similar to (a) above.

2.4.2.13 CR -- Carriage Return (Reference Number 13). A formatting control character which:

a) moves the printing position horizontally, right to left, to the first printing position on the same printing line, and,

b) is applicable to display devices, in a manner similar to (a) above.

2.4.2.14 SO -- Shift Out (Reference Number 14). A mode control character which indicates that the code combinations which follow shall be interpreted as outside of the character set of the standard code table until a Shift In character is reached.

2.4.2.15 SI -- Shift In (Reference number 15). A mode control character which indicates that the code combinations which follow shall be interpreted according to the standard code table.

① 2.4.2.16 DLE -- Data Link Escape (Reference Number 16). A communication mode control character which will change the meaning of a limited number of contiguously following characters. It is used exclusively to provide supplementary controls in data communication networks.

2.4.2.17 DC1 -- Device Control 1 (Reference Number 17). A device control character which controls ancillary devices associated with data processing or telecommunication systems, more especially switching devices "on" or "off".

2.4.2.18 DC2 -- Device Control 2 (Reference Number 18). A device control character which controls ancillary devices associated with data processing or telecommunication systems, more especially switching devices "on" or "off".

2.4.2.19 TM -- Tape Mark. Also, DC3 -- Device Control 3 (Reference Number 19). A device control character which when recorded in a special single character control block (no CRC, but with LRC) on one-half inch, 800 BPI, 9 track magnetic tape serves to cause a special device status indication. The detection of this special single character control block by a tape control unit causes a special device status indication, without the transfer to main storage of the TM character. Tape control unit and channel hardware in general and programming practice always, require that the special control block be written on tape by execution of a channel command. The transfer of the TM character as a single character block will not create the special control block which when detected causes the special device status indication. This character within a multiple byte block or in other tape formats has no special meaning. ①

2.4.2.20 RES -- Restore (Reference Number 20). A mode control character which terminates the Bypass mode of operation.

2.4.2.21 NL -- New Line (Reference Number 21). A formatting control character which:

a) moves the printing position horizontally, right to left, and vertically, top to bottom, to the first printing position of the next printing line,

b) advances the writing beam of the cathode ray tube of a display device to the left most position of the next display line-section, ④

c) advances a card to the next field defined by field definition controls, and,

d) may be provided by a device on a half-line basis (i.e., New Half Line) if and only if New Line is not provided by that device on a full-line basis.

2.4.2.22 BS -- Backspace (Reference Number 22). A formatting control characer which:

a) moves the printing position horizontally, right to left, to the next printing position to the left, and, ① ④

b) is applicable to display devices in a manner similar to (b) above.

2.4.2.23 IL -- Idle (Reference Number 23). A synchronization control character which serves as a "No-Operation" fill character for perforated tape and on transmission lines. ④

2.4.2.24 CAN -- Cancel (Reference Number 24). An error control character which is used to indicate that the data with which it is sent is in error or is to be disregarded.

2.4.2.25 EM -- End of Medium (Reference Number 25). A grouping control character associated with the sent data which may be used to identify the physical end of the medium, or the end of the used, or wanted, portion of information recorded on a medium. (The position of this character does not necessarily correspond to the physical end of the medium.) ①

2.4.2.26 CC -- Cursor Control (Reference Number 26). A grouping control character which, for some buffer read operations used in conjunction with some display devices, when a cursor bit is detected in a data byte in the buffer, is transmitted to main storage instead of that data byte. ④

2.4.2.27 CUI -- Customer Use 1 (Reference Number 27). A customer use control character sent into a system to designate a customer assigned function (see 2.4.1.1).

2.4.2.28 IFS -- Interchange File Separator (Reference Number 28). A grouping control character which terminates an information block called a FILE (see definitions of IGS, IRS, IUS).

When used in hierarchical order, the hierarchical order is ascending, IUS, IRS, IGS, IFS.

An information block must not be split by a higher order separator; *e.g.*, a RECORD may contain a whole number of UNITS, but may not contain a part of a UNIT.

2.4.2.29 IGS -- Interchange Group Separator (Reference Number 29). A grouping control character which terminates an information block called a GROUP (see definition of IFS, Interchange File Separator). ①

2.4.2.30 IRS -- Interchange Record Separator (Reference Number 30). A grouping control character which terminates an information block called a RECORD (see definition of IFS, Interchange File Separator).

2.4.2.31 IUS -- Interchange Unit Separator (Reference Number 31). A grouping control character which terminates an information block called a UNIT (see definition of IFS, Interchange File Separator).

2.4.2.32 DS -- Digit Select (Reference Number 32). An editing control character which causes either a digit from the source field or a fill character to be inserted in the result field, in CPU editing operations.

2.4.2.33 SCS -- Start of Significance (Reference Number 33). An editing control character which causes either a digit from the source field or a fill character to be inserted in the result field, and also indicates by setting a trigger, that the following digits are significant in CPU editing operations.

2.4.2.34 FS -- Field Separator (Reference Number 34). An editing control character which identifies individual fields in a multiple -- field CPU editing operation.

2.4.2.35 (Reference Number 35). A control character reserved for assignment of future functions.

2.4.2.36 BYP -- Bypass (Reference Number 36). A mode control character which in the normal mode (frequently identified in terminal equipment as the program mode) causes the succeeding control characters except Restore (RES), End of Transmission (EOT), and End of Block (EOB) to be ignored and deactivates associated printers. ④

2.4.2.37 LF -- Line Feed (Reference Number 37). A formatting control character which:

a) moves the printing position vertically, top to bottom, to the next printing line,

b) is applicable to display devices in a manner similar to (a) above, and,

c) may be provided by devices on a half-line basis (*i.e.*, Half Line Feed) if and only if Line Feed is not provided by that device on a full-line basis.

2.4.2.38 ETB -- End of Transmission Block Also, EOB -- End of Block (Reference Number 38). A communication grouping control character which indicates the end of a block of data for transmission purposes.

NOTE: The preferred designation shall be ETB -- End of Transmission Block, and *not* EOB -- End of Block.

2.4.2.39 ESC -- Escape. Also PRF -- Prefix ① (Reference Number 39). A mode control ④ character which may be used to extend the standard character set of the code table. It is a warning or non locking shift character which changes the meaning of the next single following code combination. The precise meaning of the character following Escape requires prior agreement between the sender and the recipient of the data. Where required, the character following Escape may extend the Escape sequence.

Escape sequences are used primarily to obtain additional control functions which may provide amongst other things graphic or graphic sets outside the standard set. Such control functions must not be used as additional Communication Controls.

Null and Delete and the ten Communication Controls (SOH, STX, ETX, DLE, ETB, ENQ, ACK, SYN, EOT, NAK) must not be used in defining Escape sequences. Where they appear in an actual Escape sequence they shall retain their standard meaning and be disregarded in the interpretation of the Escape sequence.

① The use of certain Escape sequences will be the subject of further standards.

④ NOTE: The preferred designation shall be ESC -- Escape, and not PRE -- Prefix.

2.4.2.40 (Reference Number 40). A control character reserved for assignment of future functions.

2.4.2.41 (Reference Number 41). A control character reserved for assignment of future functions.

2.4.2.42 SM -- Set Mode (Reference Number 42). A mode control character which sets a new mode of operation.

④ 2.4.2.43 CU2 -- Customer Use 2 (Reference Number 43). A customer use control character sent into a system to designate a customer assigned function (see 2.4.1.1).

2.4.2.44 (Reference Number 44). A control character reserved for assignment of future functions.

2.4.2.45 ENQ -- Enquiry (Reference Number 45). A communication error control character which is used in data communication systems as a request for a response from a remote station. It may be used as a "Who Are You" (WRU) to obtain identification, or may be used to obtain station status, or both.

① 2.4.2.46 ACK -- Acknowledge (Reference Number 46). A communication error control character which is transmitted by a receiver as an affirmative response to a sender.

2.4.2.47 BEL -- Bell (Reference Number 47). An error (or alarm) control character which is used when there is a need to call for human attention. It may control alarm or attention devices.

2.4.2.48 (Reference Number 48). A control character reserved for assignment of future functions.

2.4.2.49 (Reference Number 49). A control character reserved for assignment of future functions.

① 2.4.2.50 SYN -- Synchronous Idle (Reference Number 50). A communication synchronization control character which is used by a synchronous transmission system in the absence of any other character to provide a signal from which synchronism may be achieved or retained.

2.4.2.51 (Reference Number 51). A control character reserved for assignment of future functions.

2.4.2.52 PN -- Punch On (Reference Number 52). A device control character which activates a perforated tape punch.

2.4.2.53 RS -- Reader Stop (Reference Number 53). A device control character which stops a reading device, such as a perforated tape or card reader.

2.4.2.54 UC -- Upper Case (Reference Number 54). A mode control character which shifts the BCD Perforated Tape and Transmission Code to the Upper Case Mode. All characters which follow this precedence character are in the Upper Case Mode until a Lower Case control character is reached.

2.4.2.55 EOT -- End of Transmission (Reference Number 55). A communication grouping control character which is used to indicate the conclusion of a transmission, which may have contained one or more texts and any associated headings.

2.4.2.56 (Reference Number 56). A control character reserved for assignment of future functions.

2.4.2.57 (Reference 57). A control character reserved for assignment of future functions.

2.4.2.58 (Reference Number 58). A control character reserved for assignment of future functions.

2.4.2.59 CU3 -- Customer Use 3 (Reference Number 59). A customer use control character sent into a system to designate a customer assigned function (see 2.4.1.1).

2.4.2.60 DC4 -- Device Control 4 (Reference Number 60). A device control character which controls ancillary devices associated with data processing or telecommunication systems, more especially switching devices "on" or "off". (If a single "stop" control is required to interrupt or turn off ancillary devices, DC4 is the preferred assignment.)

2.4.2.61 NAK -- Negative Acknowledge (Reference Number 61). A communication error control character which is transmitted by a receiver as a negative response to the sender.

2.4.2.62 (Reference Number 62). A control character reserved for assignment of future functions.

① 2.4.2.63 SUB -- Substitute: Also, CH -- Check (Reference Number 63). An error control character which replaces a character which is determined to be invalid or in error, or, for graphic display devices is inserted at the end of a message to signify that some character or characters in the message are in error.

NCTE: The preferred designation shall be SUB -- Substitute, and not CH -- Check.

2.4.2.255 EO -- Eight Ones (Reference Number 255). An error control character which is used instead of Delete (Reference Number 7) on 8-bit BCD paper tape.

NCTE:

④ Delete and Eight Ones. These two characters have a somewhat similar function in two related media environments, paper tape and data communications, and in three different code environments, as follows:

a) EBCDIC (this standard). When EBCDIC is punched in paper tape, or transmitted on data communications lines, and either a character with eight one-bits, or the equivalent of a Delete character is required, the Eight Cnes character (Reference Number 255) should be used.

b) PTTC/EBCD (CSS 2-8015-003). In the shifted 6-bit code environment of PTTC, when a Delete character is required, the Delete character (Reference Number 7) should be used. If the application is for transmission from an 8-bit EBCDIC environment, then the EBCDIC bit-pattern for Delete must first be translated, by programming and/or hardware as appropriate, to the 6-bit PTTC bit-pattern for Delete.

③ ④ c) The 7-Bit Code. In the 7-bit code environment (see 3.5), when a Delete character is required, the Delete character (Reference Number 7) should be used. The 7-bit bit-pattern for Delete is 111 1111, from high to low order bit. If the application is for transmission from an 8-bit EBCDIC environment, then the EBCDIC bit-pattern for Delete must first be translated, by programming and/or hardware as appropriate, to the 7-bit bit-pattern for Delete.

④ 2.4.4 Escape Sequence. The Escape (or Prefix) control character (Reference Number 39, and see 2.4.2.39) has been provided as a means of obtaining additional control functions or graphics not provided in the standard character set of the code. The Escape character changes the definition of the succeeding character unless the succeeding character is either Null, Delete, Eight Ones, or any of the ten Communications Control characters (SOH, STX, ETX, ETP, ENQ, ACK, SYN, EOT, NAK). These characters will not be used in Escape sequences.

④ Escape Sequences may be assigned with, and only with, the prior approval of the Divisions, of WTC, and of the Corporate Director of Standards.

2.5 STANDARD GRAPHICS. Column 7 of Table IV gives the Standard Graphics to be used with this standard.

2.5.1 Specific Characters for use in programming products. This standard assigns, for both machine systems and programming products, specific classification to graphic characters as follows:

a) Monocase or Uppercase alphabetics: (29 total) -- A thru Z $ # @ -- (See Section 2.5.2.1 for Alphabetic Extenders)

b) Lowercase alphabetics: (29 total) -- a thru z ! " ¢ (See Section 2.5.2.1 for Alphabetic Extenders)

c) Numerics: 0 thru 9

d) Syntactics: (21 total -- including SPACE)

/	*	+	-	=	SPACE
&	|	¬	<	>	
'	.	,	:	;	
(	)	%	_	?	

2.5.1.1 IBM Product Programs must accept, interpret, and process (1) Monocase Alphabetic Extenders in the same manner as Monocase Alphabetics, and (2) Lowercase Alphabetic Extenders in the same manner as Lowercase Alphabetics.

2.5.1.2 Under No Circumstances should new programming products be developed which require the use of graphic characters (graphic and code) not as specified above (Section 2.5.1).

2.5.1.3 The Only Programming Products exempted from the above requirements are:

> Type I and Type II Programs Alpha tested prior to the effective date of this standard, and revisions or extensions of such Type I and Type II Programs.

2.5.2 National Graphic Options

2.5.2.1 Alphabetic Extenders. In countries where a Roman-based alphabet is used, alphabetic extenders are provided by replacement of some or all of the graphics # @ $ " ! ¢ as shown in Tables V and VI. These characters are indicated by AE (alphabetic extenders) in Column 8 of Table IV.

2.5.2.2 For each applicable product, the WTC Graphic Options, as described in Section 2.5.2.1 and as shown in Table V, shall be available as options unless specific agreement to do otherwise has been reached by the WTC Director of Product Programs and the program manager responsible for the product in the developing division. ⑦

2.5.2.3 For each applicable product, the WTC Graphic Options, as decribed in Section 2.5.2.1 and as shown in Table VI, shall be available as options but only after agreement to do so has been reached by the WTC Director of Product Programs and the program manager responsible for the product in the developing division.

2.5.2.4 National graphic options for countries not shown in Tables V and VI may be added as the need arises but only with the approval of all Divisions, and of WTC, and of the Corporate Director of Standards.

2.5.2.5 Sterling. Whenever a character for 10 or 11 is required to appear in a single column of a card, the 11 or 12 punch, respectively, will be used.

2.5.2.6 Non-Latin Alphabets. In countries where non-Latin alphabets are used, the applicable standard is CSS 2-8015-004, Extended BCD Interchange Code for Non-Latin Alphabets.

2.6 STANDARD NAMES. In column 9 of Table IV are given standard names for some of the graphics and controls. When two names are given, as Minus, Hyphen, it is because two different meanings are associated with the graphic.

2.7 COLLATING SEQUENCE. The collating sequence of the 256 characters is defined by the Reference Numbers of Column 1 of Table IV, which run from 0 to 255, from low to high. The collating sequence of the 64 characters of BCDIC is given by the Reference Numbers of Column 2 of the Table, which run from low to high. It is to be noted that the collating sequence of the 64 character set is embedded in the collating sequence of the 256 character set.

2.8 GRAPHIC AND CONTROL ASSIGNMENTS.

2.8.1 Graphic Assignments. Characters in Table IV with Reference Numbers from 64 to 254 inclusive are reserved for assignment to graphic characters. Graphics are not yet assigned to character positions in Table IV with the following Reference Numbers:

65 to 73
98 to 105
128
154 to 160
202
205
218 to 223
234
237 to 239

81 to 89
112
138 to 144
170 to 191
203
207
225
235
251 to 254

Assignment of specific graphics to any of these positions must have the prior approval of all Divisions, and of WTC, and of the Corporate Director of Standards.

2.8.2 Control Assignments. Characters in Table IV with Reference Numbers from 0 to 63 inclusive, and 255, are reserved for assignment to control characters. Controls are not yet assigned to character positions in Table IV with the following Reference Numbers:

8 35 40 41 44 48
49 51 56 57 58 62

Assignment of specific controls to any of these positions must have the prior approval of all Divisions, and of WTC, and of the Corporate Director of Standards.

Table I. TRACK ASSIGNMENTS FOR MAGNETIC TAPE

9 track, 1/2 inch		10 track, 1 inch	
Bit Number	Track Number	Bit Number	Track Number
Reference Edge			
5	1		1 (Check bit)
7	2		2 (Check bit)
3	3	0	3
	4 (odd parity)	1	4
2	5	2	5
1	6	3	6
0	7	4	7
6	8	5	8
4	9	6	9
		7	10
		Reference Edge	

Table II. PERFORATED TAPE AND TRANSMISSION CONTROLS

Col. 1	Col. 3	Col. 8	
Reference Numbers (correspond to column Reference numbers of Table IV)			
4	61	PF	Punch Off
5	62	HT	Horizontal Tab
6	63	LC	Lower Case
7	64	DEL	Delete
20	45	RES	Restore
21	46	NL	New Line
22	47	BS	Backspace
23	48	IL	Idle
36	29	BYP	Bypass
37	30	LF	Line Feed
38	31	ETB	End of Transmission Block
39	32	ESC	Escape
52	13	PN	Punch On
53	14	RS	Reader Stop
54	15	UC	Upper Case
55	16	EOT	End of Transmission
64	1	SP	Space

Table III. ALTERNATE CODE MEANINGS

Col. 1	Col. 2	Col. 7	Alternate Functions or Meanings
Reference	Numbers		
79	5	|	GM: Group Mark
95	11	¬	MC: Mode Change
109	16	‾	WS: Word Separator
111	18	?	SM: Segment Mark
122	19	:	SB: Substitute Blank
127	24	"	TM: Tape Mark
192	25		PZ: Plus Zero
208	35		MZ: Minus Zero
224	45		RM: Record Mark

Proposed May 15, 1968

EXTENDED BCD INTERCHANGE CODE

CSS Cat.	2-8015 Subject	002 Suffix

Table IV. CODE TABLE

1 REFERENCE NUMBERS	2	3	4	5 CARD CODE						6 8-BIT CODE		7 GRAPHICS, CONTROLS, AND SPECIAL MEANINGS	8	9 GRAPHIC AND CONTROL NAMES	10 SEE SECTION	
256	64	111E	64B	12	11	0	9	8		0123	4567					
0				12		0	9	8	1	0000	0000		NUL	Null	2.4.2	①
1				12			9		1		0001		SOH	Start of Heading	2.4.2	
2				12			9		2		0010		STX	Start of Text	2.4.2	
3				12			9		3		0011		ETX	End of Text	2.4.2	
4		61	61	12			9		4		0100		PF	Punch Off	2.4.2	
5		62	62	12			9		5		0101		HT	Horizontal Tab	2.4.2	
6		63	63	12			9		6		0110		LC	Lower Case	2.4.2	
7		64	64	12			9		7		0111		DEL	Delete	2.4.2	
8				12			9	8			1000			Reserved	2.4.2	
9				12			9	8	1		1001			Reserved	2.4.2	
10				12			9	8	2		1010		SMM	Start of Manual Message	2.4.2	④
11				12			9	8	3		1011		VT	Vertical Tab	2.4.2	①
12				12			9	8	4		1100		FF	Form Feed	2.4.2	
13				12			9	8	5		1101		CR	Carriage Return	2.4.2	
14				12			9	8	6		1110		SO	Shift Out	2.4.2	
15				12			9	8	7		1111		SI	Shift In	2.4.2	
16				12	11		9	8	1	0001	0000		DLE	Data Link Escape	2.4.2	
17					11		9		1		0001		DC1	Device Control 1	2.4.2	
18					11		9		2		0010		DC2	Device Control 2	2.4.2	
19					11		9		3		0011		TM	Tape Mark	2.4.2	
20		45	45		11		9		4		0100		RES	Restore	2.4.2	
21		46	46		11		9		5		0101		NL	New Line	2.4.2	
22		47	47		11		9		6		0110		BS	Backspace	2.4.2	
23		48	48		11		9		7		0111		IL	Idle	2.4.2	
24					11		9	8			1000		CAN	Cancel	2.4.2	①
25					11		9	8	1		1001		EM	End of Medium	2.4.2	
26					11		9	8	2		1010		CC	Cursor Control	2.4.2	④
27					11		9	8	3		1011		CU1	Customer Use 1	2.4.2	
28					11		9	8	4		1100		IFS	Interchange File Separator	2.4.2	①
29					11		9	8	5		1101		IGS	Interchange Group Separator	2.4.2	
30					11		9	8	6		1110		IRS	Interchange Record Separator	2.4.2	
31					11		9	8	7		1111		IUS	Interchange Unit Separator	2.4.2	

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Table IV (Continued)

1	2	3	4	5						6		7 8	9	10	
REFERENCE NUMBERS				CARD CODE						8-BIT CODE		GRAPHICS, CONTROLS, AND SPECIAL MEANINGS	GRAPHIC AND CONTROL NAMES	SEE SECTION	
256	64	111E	64B	12	11	0	9	8		0123	4567				
32					11	0	9	8	1	0010	0000	DS	Digit Select	2.4.2	
33						0	9		1		0001	SOS	Start of Significance	2.4.2	
34						0	9		2		0010	FS	Field Separator	2.4.2	
35						0	9		3		0011		Reserved	2.4.2	
36		29	29			0	9		4		0100	BYP	Bypass	2.4.2	
37		30	30			0	9		5		0101	LF	Line Feed	2.4.2	
38		31	31			0	9		6		0110	ETB	End of Transmission Block	2.4.2	
39		32	32			0	9		7		0111	ESC	Escape	2.4.2	
40						0	9	8			1000		Reserved	2.4.2	
41						0	9	8	1		1001		Reserved	2.4.2	
42						0	9	8	2		1010	SM	Set Mode	2.4.2	
43						0	9	8	3		1011	CU2	Customer Use 2	2.4.2	④
44						0	9	8	4		1100		Reserved	2.4.2	
45						0	9	8	5		1101	ENQ	Enquiry	2.4.2	
46						0	9	8	6		1110	ACK	Acknowledge	2.4.2	①
47						0	9	8	7		1111	BEL	Bell	2.4.2	
48				12	11	0	9	8	1	0011	0000		Reserved	2.4.2	
49							9		1		0001		Reserved	2.4.2	
50							9		2		0010	SYN	Synchronous Idle	2.4.2	①
51							9		3		0011		Reserved	2.4.2	
52		13	13				9		4		0100	PN	Punch On	2.4.2	
53		14	14				9		5		0101	RS	Reader Stop	2.4.2	
54		15	15				9		6		0110	UC	Upper Case	2.4.2	
55		16	16				9		7		0111	EOT	End of Transmission	2.4.2	
56							9	8			1000		Reserved	2.4.2	
57							9	8	1		1001		Reserved	2.4.2	
58							9	8	2		1010		Reserved	2.4.2	
59							9	8	3		1011	CU3	Customer Use 3	2.4.2	④
60							9	8	4		1100	DC4	Device Control 4	2.4.2	
61							9	8	5		1101	NAK	Negative Acknowledge	2.4.2	①
62							9	8	6		1110		Reserved	2.4.2	
63							9	8	7		1111	SUB	Substitute	2.4.2	①

Table IV (Continued)

1	2	3	4	5						6		7	8	9	10	
REFERENCE NUMBERS				CARD CODE						8-BIT CODE		GRAPHICS, CONTROLS, AND SPECIAL MEANINGS		GRAPHIC AND CONTROL NAMES	SEE SECTION	
256	64	111E	64B	12	11	0	9	8		0123	4567					
64	0	1	1	No	Punches					0100	0000		SP	Space		
65				12		0	9		1		0001					
66				12		0	9		2		0010					
67				12		0	9		3		0011					
68				12		0	9		4		0100					
69				12		0	9		5		0101					
70				12		0	9		6		0110					
71				12		0	9		7		0111					
72				12		0	9	8			1000					
73		98		12				8	1		1001					
74		76		12				8	2		1010	¢ [	AE	Cent Sign Left Bracket	2.5.2 3.5.5	②
75	1	60	60	12				8	3		1011	.		Period, Decimal Point		
76	2	66		12				8	4		1100	<		Less Than Sign	3.3	
77	3	73		12				8	5		1101	(		Left Parenthesis		
78	4	100		12				8	6		1110	+		Plus Sign		
79	5	87		12				8	7		1111	|	GM	Logical OR	2.4.1.12 3.5.5	②
80	6	49	49	12						0101	0000	&		Ampersand		
81				12	11		9		1		0001					
82				12	11		9		2		0010					
83				12	11		9		3		0011					
84				12	11		9		4		0100					
85				12	11		9		5		0101					
86				12	11		9		6		0110					
87				12	11		9		7		0111					
88				12	11		9	8			1000					
89					11			8	1		1001					
90		99			11			8	2		1010	!]	AE	Exclamation Point Right Bracket	2.5.2 3.5.5	②
91	7	44	44		11			8	3		1011	$	AE	Dollar Sign	2.5.2	
92	8	72			11			8	4		1100	*		Asterisk		
93	9	74			11			8	5		1101	)		Right Parenthesis		
94	10	67			11			8	6		1110	;		Semi Colon		
95	11	111			11			8	7		1111	¬	MC	Logical NOT	2.4.1.12 3.5.5	②

Table IV (Continued)

1	2	3	4	5						6		7	8	9	10
REFERENCE NUMBERS				CARD CODE						8-BIT CODE		GRAPHICS, CONTROLS, AND SPECIAL MEANINGS		GRAPHIC AND CONTROL NAMES	SEE SECTICN
256	64	111E	64B	12	11	0	9	8		0123	4567				
96	12	33	33		11					0110	0000	-		Minus Sign, Hyphen	
97	13	18	18			0			1		0001	/		Slash	
98					11	0	9		2		0010				
99					11	0	9		3		0011				
100					11	0	9		4		0100				
101					11	0	9		5		0101				
102					11	0	9		6		0110				
103					11	0	9		7		0111				
104					11	0	9	8			1000				
105		86				0		8	1		1001				
106				12	11						1010	¦		Vertical Line	3.5.5 ②
107	14	28	28			0		8	3		1011	,		Comma	
108	15	69				0		8	4		1100	%		Percent Sign	
109	16	88				0		8	5		1101	_	WS	Underscore	2.4.1.12
110	17	71				0		8	6		1110	>		Greater Than Sign	
111	18	77				0		8	7		1111	?	SM	Question Mark	2.4.1.12
112				12	11	0				0111	0000				
113				12	11	0	9		1		0001				
114				12	11	0	9		2		0010				
115				12	11	0	9		3		0011				
116				12	11	0	9		4		0100				
117				12	11	0	9		5		0101				
118				12	11	0	9		6		0110				
119				12	11	0	9		7		0111				
120				12	11	0	9	8			1000				
121		110						8	1		1001	\		Grave Accent	3.5.5 ②
122	19	68						8	2		1010	:	SB	Colon	2.4.1.12
123	20	12	12					8	3		1011	#	AE	Number Sign	2.5.2
124	21	17	17					8	4		1100	@	AE	At Sign	2.5.2
125	22	70						8	5		1101	'		Prime, Apostrophe	
126	23	65						8	6		1110	=		Equal Sign	
127	24	75						8	7		1111	"	AE, TM	Quotation Marks	2.5.2 2.4.1.12

Table IV (Continued)

1	2	3	4	5						6		7	8	9	10
REFERENCE NUMBERS				CARD CODE						8-BIT CODE		GRAPHICS, CONTROLS, AND SPECIAL MEANINGS		GRAPHIC AND CONTROL NAMES	SEE SECTION
256	64	111E	64B	12	11	0	9	8		0123	4567				
128				12		0		8	1	1000	0000				
129		50		12		0			1		0001	a			
130		51		12		0			2		0010	b			
131		52		12		0			3		0011	c			
132		53		12		0			4		0100	d			
133		54		12		0			5		0101	e			
134		55		12		0			6		0110	f			
135		56		12		0			7		0111	g			
136		57		12		0			8		1000	h			
137		58		12		0			9		1001	i			
138				12		0		8	2		1010				
139				12		0		8	3		1011				
140				12		0		8	4		1100				
141				12		0		8	5		1101				
142				12		0		8	6		1110				
143				12		0		8	7		1111				
144				12	11			8	1	1001	0000				
145		34		12	11				1		0001	j			
146		35		12	11				2		0010	k			
147		36		12	11				3		0011	l			
148		37		12	11				4		0100	m			
149		38		12	11				5		0101	n			
150		39		12	11				6		0110	o			
151		40		12	11				7		0111	p			
152		41		12	11				8		1000	q			
153		42		12	11				9		1001	r			
154				12	11			8	2		1010				
155				12	11			8	3		1011				
156				12	11			8	4		1100				
157				12	11			8	5		1101				
158				12	11			8	6		1110				
159				12	11			8	7		1111				

EXTENDED BCD INTERCHANGE CODE

Table IV (Continued)

1	2	3	4	5						6		7	8	9	10
REFERENCE NUMBERS				CARD CODE						8-BIT CODE		GRAPHICS, CONTROLS, AND SPECIAL MEANINGS		GRAPHIC AND CONTROL NAMES	SEE SECTION
256	64	111E	64B	12	11	0	9	8		0123	4567				
160					11	0		8	1	1010	0000				
161					11	0			1		0001	~		Tilde	3.5.5
162		19			11	0			2		0010	s			
163		20			11	0			3		0011	t			
164		21			11	0			4		0100	u			
165		22			11	0			5		0101	v			
166		23			11	0			6		0110	w			
167		24			11	0			7		0111	x			
168		25			11	0			8		1000	y			
169		26			11	0			9		1001	z			
170					11	0		8	2		1010				
171					11	0		8	3		1011				
172					11	0		8	4		1100				
173					11	0		8	5		1101				
174					11	0		8	6		1110				
175					11	0		8	7		1111				
176				12	11	0		8	1	1011	0000				
177				12	11	0			1		0001				
178				12	11	0			2		0010				
179				12	11	0			3		0011				
180				12	11	0			4		0100				
181				12	11	0			5		0101				
182				12	11	0			6		0110				
183				12	11	0			7		0111				
184				12	11	0			8		1000				
185				12	11	0			9		1001				
186				12	11	0		8	2		1010				
187				12	11	0		8	3		1011				
188				12	11	0		8	4		1100				
189				12	11	0		8	5		1101				
190				12	11	0		8	6		1110				
191				12	11	0		8	7		1111				

②

Table IV (Continued)

1	2	3	4	5						6		7	8	9	10	
REFERENCE NUMBERS				CARD CODE						8-BIT CODE		GRAPHICS, CONTROLS, AND SPECIAL MEANINGS		GRAPHIC AND CONTROL NAMES	SEE SECTION	
256	64	111E	64B	12	11	0	9	8		0123	4567					
192	25	59	59	12		0				1100	0000	{	+0	Opening Brace	2.4.1.13 3.5.5	② ⑤
193	26	101	50	12					1		0001	A	+1		2.4.1.13	
194	27	102	51	12					2		0010	B	+2		2.4.1.13	
195	28	103	52	12					3		0011	C	+3		2.4.1.13	
196	29	104	53	12					4		0100	D	+4		2.4.1.13	
197	30	105	54	12					5		0101	E	+5		2.4.1.13	⑤
198	31	106	55	12					6		0110	F	+6		2.4.1.13	
199	32	107	56	12					7		0111	G	+7		2.4.1.13	
200	33	108	57	12					8		1000	H	+8		2.4.1.13	
201	34	109	58	12					9		1001	I	+9		2.4.1.13	
202				12		0	9	8	2		1010					
203				12		0	9	8	3		1011					
204				12		0	9	8	4		1100	⑀		Hook		⑧
205				12		0	9	8	5		1101					
206				12		0	9	8	6		1110	⑂		Fork		⑧
207				12		0	9	8	7		1111					
208	35	43	43		11	0				1101	0000	}	-0	Closing Brace	2.4.1.13 3.5.5	② ⑤
209	36	89	34		11				1		0001	J	-1		2.4.1.13	
210	37	90	35		11				2		0010	K	-2		2.4.1.13	
211	38	91	36		11				3		0011	L	-3		2.4.1.13	
212	39	92	37		11				4		0100	M	-4		2.4.1.13	⑤
213	40	93	38		11				5		0101	N	-5		2.4.1.13	
214	41	94	39		11				6		0110	O	-6		2.4.1.13	
215	42	95	40		11				7		0111	P	-7		2.4.1.13	
216	43	96	41		11				8		1000	Q	-8		2.4.1.13	
217	44	97	42		11				9		1001	R	-9		2.4.1.13	
218				12	11		9	8	2		1010					
219				12	11		9	8	3		1011					
220				12	11		9	8	4		1100					
221				12	11		9	8	5		1101					
222				12	11		9	8	6		1110					
223				12	11		9	8	7		1111					

May 15, 1963 **Proposed**

CSS Cat.	2-8015 Subject	002 Suffix

EXTENDED BCD INTERCHANGE CODE

Table IV (Continued)

1 REFERENCE NUMBERS	2	3	4	5 CARD CODE						6 8-BIT CODE		7 GRAPHICS, CONTROLS, AND SPECIAL MEANINGS	8	9 GRAPHIC AND CONTROL NAMES	10 SEE SECTION	
256	64	111E	64B	12	11	0	9	8		0123	4567					
224	45	27	27			0		8	2	1110	0000	\	RM	Reverse Slant	2.4.1.12 3.5.5	②
225					11	0	9		1		0001					
226	46	78	19			0			2		0010	S				
227	47	79	20			0			3		0011	T				
228	48	80	21			0			4		0100	U				
229	49	81	22			0			5		0101	V				
230	50	82	23			0			6		0110	W				
231	51	83	24			0			7		0111	X				
232	52	84	25			0			8		1000	Y				
233	53	85	26			0			9		1001	Z				
234					11	0	9	8	2		1010					
235					11	0	9	8	3		1011					
236					11	0	9	8	4		1100	⑁		Chair		⑧
237					11	0	9	8	5		1101					
238					11	0	9	8	6		1110					
239					11	0	9	8	7		1111					
240	54	11	11						0	1111	0000	0				
241	55	2	2						1		0001	1				
242	56	3	3						2		0010	2				
243	57	4	4						3		0011	3				
244	58	5	5						4		0100	4				
245	59	6	6						5		0101	5				
246	60	7	7						6		0110	6				
247	61	8	8						7		0111	7				
248	62	9	9						8		1000	8				
249	63	10	10						9		1001	9				
250				12	11	0	9	8	2		1010	▌		Long Vertical Mark		⑧
251				12	11	0	9	8	3		1011					
252				12	11	0	9	8	4		1100					
253				12	11	0	9	8	5		1101					
254				12	11	0	9	8	6		1110					
255				12	11	0	9	8	7		1111		EO	Eight Ones	2.4.2	④

Table V. WTC GRAPHIC OPTIONS						
Reference Number	91	123	124	90	127	74
Card Code	11-8-3	8-3	8-4	11-8-2	8-7	12-8-2
Bit Code	0101-1011	0111-1011	0111-1100	0101-1010	0111-1111	0100-1010
Country						
Austria/Germany	Ü	Ä	Ö	ü	ä	ö
Belgium/France	F	é	à	è	ù	ç
Denmark/Norway	Å	Æ	Ø	å	ae	/
Finland/Sweden	Å	Ä	Ö	å	ä	ö
Italy	$	ì	ò	è	ù	à
Spanish Speaking	Pts	Ñ	@	!	ñ	¢
U. K.	£	#	@	!	"	$
U. S. A.	$	#	@	!	"	¢

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⑦

Table VI. WTC GRAPHIC OPTIONS						
Reference Number	91	123	124	90	127	74
Card Code	11-8-3	8-3	8-4	11-8-2	8-7	12-8-2
Bit Code	0101-1011	0111-1011	0111-1100	0101-1010	0111-1111	0100-1010
Country						
Bulgaria	JB	#	@	!	"	¢
Hungary	Ft	É	Á	Ö	"	Ü
Portuguese Speaking	Ç	Õ	Ã	ç	õ	ã
Yugoslavia	Č	Š	Ž	Ć	Đ	Currency Symbol
Turkey	İ	Ö	Ş	Ğ	Ü	Ç

⑦

⑦

SUPPLEMENTARY INFORMATION

3.1 DIFFERENCES BETWEEN EQUIPMENT FOR BCDIC AND EBCDIC. It should be recognized that some equipment designed for use in 6-bit BCD environments have different code-to-graphic assignments than those prescribed by this standard.

3.2 NAME OF CODE. In the internal and external documents:

a) The code of this standard should be referred to as the Extended BCD Interchange Code and may be abbreviated EBCDIC for convenience.

b) The card code of EBCDIC should be referred to as the Extended BCD Card Code.

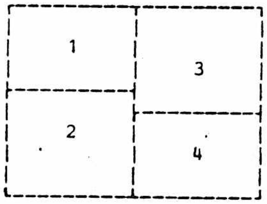
c) The magnetic tape code of EBCDIC should be referred to as the Extended BCD Magnetic Tape Code.

d) The CPU code of EBCDIC should be referred to as the Extended BCD CPU Code.

3.3 LOZENGE. The standard graphic for Reference Number 76 is " < " (Less Than Sign). Where, within a specific customer installation, a customer requirement exists for compatibility with previously installed equipment, the graphic "⌑" (Lozenge) may continue to be provided, and, if provided, will be in the code position of Reference Number 76.

3.4 16 by 16 CODE CHART. For reference purposes, bit-patterns, card hole-patterns, graphics and controls from Table IV are shown rearranged into a 16 by 16 matrix in Table VIII. This 16 by 16 code chart shows the graphic characters and control character representations for EBCDIC. The bit-position numbers (bits), bit-patterns, hexadecimal (hex) representations and card hole patterns for these and other possible EBCDIC characters are also shown.

To find the card hole patterns for most characters, partition the 256-position table into four blocks as follows:



Block 1: Zone punches at top of table; digit punches at left

Block 2: Zone punches at bottom of table; digit punches at left

Block 3: Zone punches at top of table; digit punches at right

Block 4: Zone punches at bottom of table; digit punches at right

Fifteen positions in the table are exceptions to the above arrangement. These positions are indicated by small numbers in the upper right corners of their boxes in the table. The card hole patterns for these positions are given at the bottom of the Table. Bit-position numbers, bit patterns, and hexadecimal representations for these positions are found in the usual manner.

Table VII shows some examples of the use of the EBCDIC chart.

3.5 EBCDIC, 7-BIT CODE, HOLLERITH RELATIONSHIPS.

3.5.1.1 ISO-7. The International Standards Organization Recommendation for 6 and 7 BIT CODED CHARACTER SETS FOR INFORMATION PROCESSING INTERCHANGE (officially designated ISO/R646-1967) consists of a 64 character, 6-bit code and a 128 character, 7-bit code, primarily intended as a data interchange and communications code. Only the 7-bit code is of interest in this document and it is referred to in this document as ISO-7. National versions of ISO-7 are being standardized.

3.5.1.2 USASCII. The USA Standard Code for Information Interchange (officially designated as USAS X3.4-1967) is a 128-character, 7-bit code, primarily intended as a data interchange and communications code. It is colloquially called "USASCII" or "ASCII" with "USASCII" being the preferred designation in IBM literature.

3.5.2 Hollerith. At the time of publication of this standard, there is a proposed USA Standard Hollerith Card Code for Information Interchange. It is a 128-character card code, which assigns 128 card hole-patterns to the 128 characters of the 7-Bit Code. ③

3.5.3 7-Bit Code/Hollerith Code Chart. The combined 7-Bit Code/Hollerith code chart is shown in Table IX. The 7-Bit Code graphic or control character, and the Hollerith card hole-patterns are shown for each of the 128 code-positions.

3.5.4 7-Bit Code Table Positional Notation. In the 7-Bit Code, a code table positional notation is used. The eight columns of the code table are numbered 0 through 7. The sixteen rows of the code table are numbered 0 through 15. Then a code table position is referred to as x/y, where x is the column number, and y is the row number. For example, the 7-Bit Code graphic "R" is in table position 5/2.

③ 3.5.5 Correspondence Between 7-Bit Code Hollerith and EBCDIC. Data from 7-Bit Code/Hollerith environments may enter 8-bit EBCDIC environments. In such cases, it may be necessary to translate the characters before further processing. The correspondence to be used for translation is shown in Table X. In the EBCDIC code table, the 128 7-Bit Code characters are shown. The graphic or control character is shown, and also the 7-Bit Code code table position. Some anomalies between the 7-Bit Code and EBCDIC are to be noted.

a) In hexadecimal code position 13 is shown the 7-Bit Code character Device Control 3 (DC3). The corresponding EBCDIC character is Tape Mark (TM).

b) In hexadecimal positions 1C, 1D, 1E, 1F are shown the 7-Bit Code characters File Separator, Group Separator, Record Separator, Unit Separator (FS, GS, RS, US). The corresponding EBCDIC characters are Interchange File Separator, Interchange Group Separator, Interchange Record Separator, and Interchange Unit Separator (IFS, IGS, IRS, IUS).

c) In hexadecimal code positions 4A and 5A are shown 7-Bit Code graphics Left Bracket ([) and Right Bracket (]). These correspond to EBCDIC graphics Cent Sign (¢) and Exclamation Point (!).

d) In hexadecimal positions 4F and 5F are shown the EBCDIC graphics Logical OR (|) and the Logical NOT (¬). These correspond to USASCII graphics Exclamation Point (!) and Circumflex (^). However, the substitution of "|" and "¬" for USASCII "!" and "^" is specifically permitted in the USASCII and Hollerith standards. ③

e) In ISO-7, preferred graphics are not yet assigned to ISO-7 code positions 5/12, 6/0, 7/11, 7/12, 7/13, 7/14.

Table VII. Examples of Use of EBCDIC Chart

Character	Type	Bit Pattern	Hex	Hole Pattern	
		01 23 4567		Zone Punches	Digit Punches
PF	Control Character	00 00 0100	04	12 - 9	-4
%	Special Graphic	01 10 1100	6C	0	-8-4
R	Upper Case	11 01 1001	D9	11	-9
a	Lower Case	10 00 0001	81	12 - 0	-1
	Control Character, function not yet assigned	00 11 0000	30	12 - 11 -0- 9	-8-1

TABLE VIII. EXTENDED BCD INTERCHANGE CODE

			00				01				10				11				BITS 0,1
			00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	BITS 2,3
			0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	FIRST HEXADECIMAL DIGIT
			12				12	12		12	12	12		12	12				ZONE PUNCHES
				11				11	11	11		11	11	11		11			
					0		0		0	0	0		0	0			0		
			9	9	9	9	9	9	9	9									
BITS 4 5 6 7	SECOND HEX DIGIT	DIGIT PUNCHES																	DIGIT PUNCHES
0000	0	8-1	① NUL	② DLE	③ DS	④	⑤ SP	⑥ &	⑦ -	⑧					⑨ {	⑩ }	⑪ \	⑫ 0	8-1
0001	1	1	SOH	DC1	SOS				⑬ /		a	j	~		A	J	⑭	1	1
0010	2	2	STX	DC2	FS	SYN					b	k	s		B	K	S	2	2
0011	3	3	ETX	TM							c	l	t		C	L	T	3	3
0100	4	4	PF	RES	BYP	PN					d	m	u		D	M	U	4	4
0101	5	5	HT	NL	LF	RS					e	n	v		E	N	V	5	5
0110	6	6	LC	BS	ETB	UC					f	o	w		F	O	W	6	6
0111	7	7	DEL	IL	ESC	EOT					g	p	x		G	P	X	7	7
1000	8	8		CAN							h	q	y		H	Q	Y	8	8
1001	9	8-1		EM						\	i	r	z		I	R	Z	9	9
1010	A	8-2	SMM	CC	SM		¢	!	⑮ ¦	:								LVM	8-2
1011	B	8-3	VT	CU1	CU2	CU3	.	$	,	#									8-3
1100	C	8-4	FF	IFS		DC4	<	*	%	@					⑀		⑁		8-4
1101	D	8-5	CR	IGS	ENQ	NAK	(	)	—	'									8-5
1110	E	8-6	SO	IRS	ACK		+	;	>	=					⑂				8-6
1111	F	8-7	SI	IUS	BEL	SUB	|	¬	?	"								EO	8-7
			12				12				12	12		12	12	12		12	Zone Punches
				11				11				11	11	11		11	11	11	
					0				0		0		0	0	0		0	0	
			9	9	9	9									9	9	9	9	

Card Hole Patterns

① 12-0-9-8-1
② 12-11-9-8-1
③ 11-0-9-8-1
④ 12-11-0-9-8-1
⑤ No Punches
⑥ 12
⑦ 11
⑧ 12-11-0
⑨ 12-0
⑩ 11-0
⑪ 0-8-2
⑫ 0
⑬ 0-1
⑭ 11-0-9-1
⑮ 12-11

Control Character Representations

NUL	Null
SOH	Start of Heading
STX	Start of Text
ETX	End of Text
PF	Punch Off
HT	Horizontal Tab
LC	Lower Case
DEL	Delete
SMM	Start of Manual Message
VT	Vertical Tab
FF	Form Feed
CR	Carriage Return
SO	Shift Out
SI	Shift In

DLE	Data Link Escape
DC1	Device Control 1
DC2	Device Control 2
TM	Tape Mark
RES	Restore
NL	New Line
BS	Backspace
IL	Idle
CAN	Cancel
EM	End of Medium
CC	Cursor Control
CU1	Customer Use 1
IFS	Interchange File Separator
IGS	Interchange Group Separator
IRS	Interchange Record Separator
IUS	Interchange Unit Separator

DS	DIGIT Select
SOS	Start of Significance
FS	Field Separator
BYP	Bypass
LF	Line Feed
ETB	End of Transmission Block
ESC	Escape
SM	Set Mode
CU2	Customer Use 2
ENQ	Enquiry
ACK	Acknowledge
BEL	Bell

SYN	Synchronous Idle

PN	Punch On
RS	Reader Stop
UC	Upper Case
EOT	End of Transmission
CU3	Customer Use 3
DC4	Device Control 4
NAK	Negative Acknowledge
SUB	Substitute

SP	Space
EO	Eight Ones
LVM	Long Vertical Mark

Special Graphic Characters

¢	Cent Sign
.	Period, Decimal Point
<	Less-than Sign
(	Left Parenthesis
+	Plus Sign
|	Logical OR
&	Ampersand
!	Exclamation Point
$	Dollar Sign
*	Asterisk
)	Right Parenthesis
;	Semicolon
¬	Logical NOT
-	Minus Sign, Hyphen
/	Slash
,	Comma
%	Percent
_	Underscore
>	Greater-than Sign
?	Question Mark
:	Colon
#	Number Sign
@	At Sign
'	Prime, Apostrophe
=	Equal Sign
"	Quotation Mark
⑁	Chair
⑂	Fork
⑀	Hook
¦	Vertical Line
`	Grave Accent
~	Tilde
{	Opening Brace
}	Closing Brace
\	Reverse Slant

TABLE IX. 7-BIT CODE/HOLLERITH CODE TABLE

Col→	0	1	2	3	4	5	6	7
Row↓ 0	NUL 12-0-9-8-1	DLE 12-11-9-8-1	SP no punches	0 0	@ ① 8-4	P 11-7	③ 8-1	p 12-11-7
1	SOH 12-9-1	DC1 11-9-1	| 12-8-7	1 1	A 12-1	Q 11-8	a 12-0-1	q 12-11-8
2	STX 12-9-2	DC2 11-9-2	" 8-7	2 2	B 12-2	R 11-9	b 12-0-2	r 12-11-9
3	ETX 12-9-3	DC3 11-9-3	# ④ 8-3	3 3	C 12-3	S 0-2	c 12-0-3	s 11-0-2
4	EOT 9-7	DC4 9-8-4	$ 11-8-3	4 4	D 12-4	T 0-3	d 12-0-4	t 11-0-3
5	ENQ 0-9-8-5	NAK 9-8-5	% 0-8-4	5 5	E 12-5	U 0-4	e 12-0-5	u 11-0-4
6	ACK 0-9-8-6	SYN 9-2	& 12	6 6	F 12-6	V 0-5	f 12-0-6	v 11-0-5
7	BEL 0-9-8-7	ETB 0-9-6	' 8-5	7 7	G 12-7	W 0-6	g 12-0-7	w 11-0-6
8	BS 11-9-6	CAN 11-9-8	(12-8-5	8 8	H 12-8	X 0-7	h 12-0-8	x 11-0-7
9	HT 12-9-5	EM 11-9-8-1	) 11-8-5	9 9	I 12-9	Y 0-8	i 12-0-9	y 11-0-8
10	LF 0-9-5	SUB 9-8-7	* 11-8-4	: 8-2	J 11-1	Z 0-9	j 12-11-1	z 11-0-9
11	VT 12-9-8-3	ESC 0-9-7	+ 12-8-6	; 11-8-6	K 11-2	[① 12-8-2	k 12-11-2	② 12-0
12	FF 12-9-8-4	FS 11-9-8-4	, 0-8-3	< 12-8-4	L 11-3	② 0-8-2	l 12-11-3	② 12-11
13	CR 12-9-8-5	GS 11-9-8-5	- 11	= 8-6	M 11-4	] ① 11-8-2	m 12-11-4	② 11-0
14	SO 12-9-8-6	RS 11-9-8-6	. 12-8-3	> 0-8-6	N 11-5	¬ ③ 11-8-7	n 12-11-5	③ 11-0-1
15	SI 12-9-8-7	US 11-9-8-7	/ 0-1	? 0-8-7	O 11-6	_ 0-8-5	o 12-11-6	DEL 12-9-7

③

① National Use. Graphic shown is preferred when other National Use is not required.
② National Use.
③ National Use when 8, 9 or 10 National Use characters are required.
④ When the £ symbol is required, it should replace the # symbol.

TABLE X. EBCDIC AND 7-BIT CODE/HOLLERITH CORRESPONDENCES

			00				01				10				11				BITS 0,1
			00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	BITS 2,3
			0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	FIRST HEX DIGIT
			12				12	12		12	12	12		12	12				ZONE PUNCHES
				11				11	11	11		11	11	11		11			
					0		0		0	0	0		0	0			0		
BITS 4 5 6 7	SECOND HEX DIGIT	DIGIT PUNCHES	9	9	9	9	9	9	9	9									DIGIT PUNCHES
0000	0	8-1	① NUL 0/0	② DLE 1/0	③	④	⑤ SP 2/0	⑥ & 2/6	⑦ - 2/13	⑧					⑨ [7/11	⑩ } 7/13	⑪ \ 5/12	⑫ 0 3/0	8-1
0001	1	1	SOH 0/1	DC1 1/1					⑬ / 2/15		a 6/1	j 6/10	7/14		A 4/1	J 4/10	⑭	1 3/1	1
0010	2	2	STX 0/2	DC2 1/2		SYN 1/6					b 6/2	k 6/11	s 7/3		B 4/2	K 4/11	S 5/3	2 3/2	2
0011	3	3	ETX 0/3	DC3 1/3							c 6/3	l 6/12	t 7/4		C 4/3	L 4/12	T 5/4	3 3/3	3
0100	4	4									d 6/4	m 6/13	u 7/5		D 4/4	M 4/13	U 5/5	4 3/4	4
0101	5	5	HT 0/9		LF 0/10						e 6/5	n 6/14	v 7/6		E 4/5	N 4/14	V 5/6	5 3/5	5
0110	6	6		BS 0/8	ETB 1/7						f 6/6	o 6/15	w 7/7		F 4/6	O 4/15	W 5/7	6 3/6	6
0111	7	7	DEL 7/15		ESC 1/11	EOT 0/4					g 6/7	p 7/0	x 7/8		G 4/7	P 5/0	X 5/8	7 3/7	7
1000	8	8		CAN 1/8							h 6/8	q 7/1	y 7/9		H 4/8	Q 5/1	Y 5/9	8 3/8	8
1001	9	8-1		EM 1/9						6/0	i 6/9	r 7/2	z 7/10		I 4/9	R 5/2	Z 5/10	9 3/9	9
1010	A	8-2					[5/11	] 5/13	⑮ 7/12	: 3/10									8-2
1011	B	8-3	VT 0/11				. 2/14	$ 2/4	, 2/12	# 2/3									8-3
1100	C	8-4	FF 0/12	FS 1/12		DC4 1/4	< 3/12	* 2/10	% 2/5	@ 4/0									8-4
1101	D	8-5	CR 0/13	GS 1/13	ENQ 0/5	NAK 1/5	(2/8	) 2/9	_ 5/15	' 2/7									8-5
1110	E	8-6	SO 0/14	RS 1/14	ACK 0/6		+ 2/11	; 3/11	> 3/14	= 3/13									8-6
1111	F	8-7	SI 0/15	US 1/15	BEL 0/7	SUB 1/10	| 2/1	¬ 5/14	? 3/15	" 2/2									8-7
			12				12				12	12		12	12	12		12	Zone Punches
				11				11				11	11	11		11	11	11	
					0				0		0		0	0	0		0	0	
			9	9	9	9									9	9	9	9	

Card Hole Patterns

① 12-0-9-8-1
② 12-11-9-8-1
③ 11-0-9-8-1
④ 12-11-0-9-8-1
⑤ No Punches
⑥ 12
⑦ 11
⑧ 12-11-0
⑨ 12-0
⑩ 11-0
⑪ 0-8-2
⑫ 0
⑬ 0-1
⑭ 11-0-9-1
⑮ 12-11

THE LIBRARY OF CONGRESS
WASHINGTON, D. C. 20540

Information Systems Office

July 31, 1968

Dear Mr. Bemer:

This is in response to your letter of July 23 on the use of the USASCII code with information in the MARC II format.

All tapes distributed by the Library of Congress in the MARC II format will use USASCII. However, the character set needed for bibliographic information is much larger than can be accommodated by a 7-bit code. Since the Library will distribute on 9-level tapes, it was decided to extend the 7-bit USASCII to 8 bits. This extension was designed after some consultation with L. L. Griffin at the National Bureau of Standards.

The Library of Congress character set is shown on the enclosed matrix. The first eight columns constitute the standard USASCII. Some of the standard USASCII characters--such as the braces or the backwards slash--will not be used in the Library character set. However, no characters will be substituted for these code positions. Other characters, such as the diacritical marks, will be left in their standard position (unused) and duplicated in another portion of the code set reserved for special characters and diacriticals.

The Library of Congress will also distribute 7-level tapes. The 6-bit code used on these tapes will be derived by removing the 6th and 8th bits. Columns 2, 3, 6 and 7 on the enclosed matrix represent the standard 6-bit set. All other characters will be reached by the use of non-locking shift codes.

Please let us know if we can provide any further information on this matter.

Sincerely,

Henriette D. Avram
Assistant Coordinator of
Information Systems

Mr. R. W. Bemer
Member, USASI X3
General Electric Company
13430 North Black Canyon Highway
Phoenix, Arizona 85029

N MAH 310/6

Proposed Extended

ASCII

Character Set

═══ Standard 6-bit set
------- Non-standard set 1
········ Non-standard set 2

8 7 6 5 BITS		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
4 3 2 1 BITS		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0	NUL	DLE	SP	0	@	P	` [2]	p			ʼ	ʻ			̉	¸
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q			Ł	ł			`	˛
0 0 1 0	2	STX	DC2	"	2	B	R	b	r			Ø	ø			´	.
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s			Đ	đ			^	..
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t			Þ	þ			~	˳
0 1 0 1	5	ENQ	NAK	% [1]	5	E	U	e	u			Æ	æ			¯	=
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v			Œ	œ			˘	—
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w			ʹ	ʺ			˙	̜
1 0 0 0	8	BS	CAN	(	8	H	X	h	x			·	ı			¨	̨
1 0 0 1	9	HT	EM	)	9	I	Y	i	y			♭	£			ˇ	‿
1 0 1 0	A	LF	SUB	*	:	J	Z	j	z			®	ð			˚	︢
1 0 1 1	B	VT	ESC	+	;	K	[	k	{ [5,1]			±				︠	︣
1 1 0 0	C	FF	FS	,	<	L	\ [1]	l	| [4,1]			Ơ	ơ			︡	
1 1 0 1	D	CR	GS [3]	-	=	M	]	m	} [5,1]			Ư	ư			̕	
1 1 1 0	E	SO	RS [3]	.	>	N	^ [2]	n	~ [2]							˝	̓
1 1 1 1	F	SI	US [3]	/	?	O	_ [2]	o	DEL							̐	..

Key:

1 Not on proposed print train.

3 To be used as terminators or delimiters.

4 To be used as escape codes.